Railway Engineering and Maintenance

Tight Bolts Increase the Strength of Track Joints and—

IMPROVED HIPOWER keeps track bolts tight. It imparts tension to the bolts—and as track joints wear and looseness strives to develop, the super reactive pressure of IMPROVED HIPOWER forces the joint bars into their proper places. As a result, IMPROVED HIPOWER assures a secure joint, the kind which more nearly approaches the ideal condition of a continuous rail.

THE NATIONAL LOCK WASHER CO.
NEWARK, N. J., U. S. A.

IMPROVED HIPOWER

HY-CROME

TO Maintenance of Way Engineers Hy-Crome has become a symbol of strength sustained by its lasting endurance.

Hy-Crome is a specialized metal; in its non-fatiguing spring action is found permanent track joint security impossible to secure from any common nut lock.

THE RELIANCE MFG. CO.
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N. S. Kenney, Munsey Bldg., Baltimore, Md.
Montreal, Quebec, Canada, McGill Bldg., Engineering Materials, Ltd.

RAILWAY ENGINEERING AND MAINTENANCE

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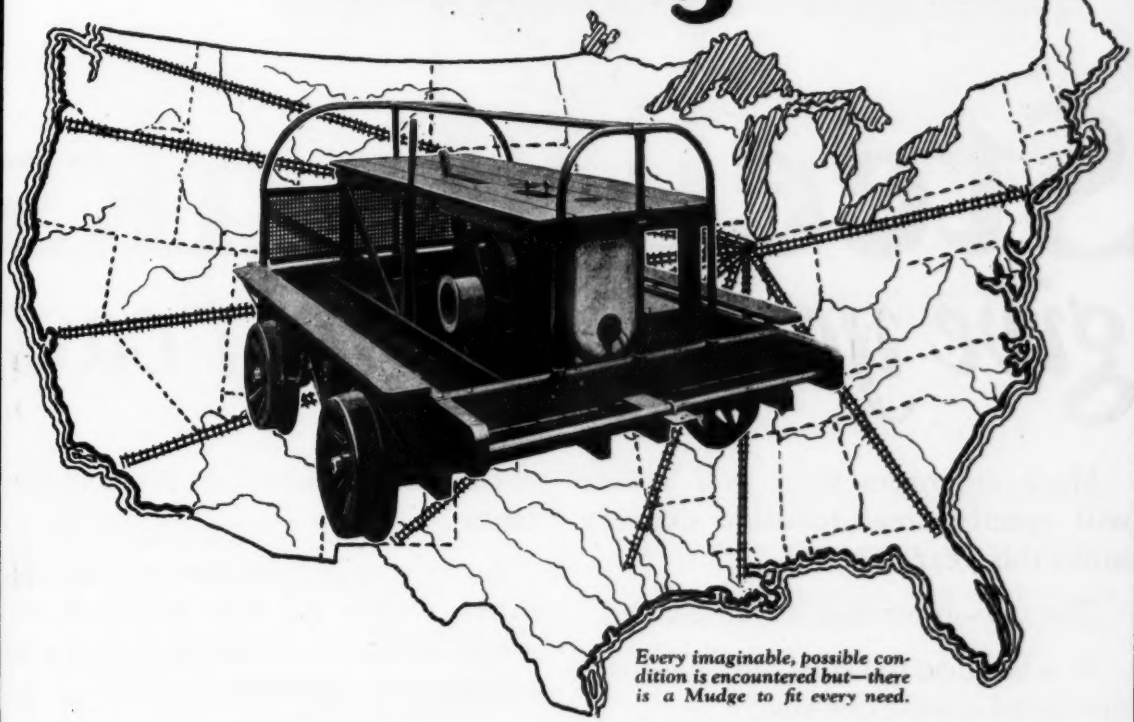
Alphabetical Index to Advertisers, Page 44 Classified Index to Advertisers, Pages 42 & 44

A Big Country — and A Big Service



Every imaginable, possible condition is encountered but—there is a Mudge to fit every need.

With Mudge Motor Cars in successful operation on railroads over the whole country—standard on many roads—our knowledge of conditions is nation wide. Our ability to build cars to fit those conditions is proven by performance.

Our experience of 17 years has taught us to specialize on motor cars as a group of several models rather than on some special theory of construction.

We have learned that no single type of car can cover all your conditions or meet all your requirements. The water cooled car may be best for one section and the air cooled for another.

We build both types, free running and direct connected and make it our business to study your needs so you may get satisfactory service from the car we recommend.

Catalog on request.

Mudge & Company

Manufacturers—Railroad Equipment
Railway Exchange Bldg. • CHICAGO

Steel Tanks give you lowest last cost

More engineers than ever before will specify *steel* roadside delivery tanks this year.

The reason for this is well defined.

It is because the *steel* tank has demonstrated lowest last cost.

Lowest last cost gives you longest life and smallest upkeep.

As a result of it the judgment of the engineer who specifies a *steel* elevated tank is justified by actual performance over a long period of years.

No engineer ever had to apologize to the management for a Horton *Steel* tank.

As long as he lives the Horton *steel* tanks which he has specified will stand as permanent reminders of good engineering selection.

To the management, the steel tank gives long, honest service, a capable, handsome appearance in keeping with other modern equipment, and a lasting, inexpensive satisfaction.

This is the age of steel because it is the age of good engineering judgment.

CHICAGO BRIDGE & IRON WORKS

CHICAGO	NEW YORK	DALLAS	SAN FRANCISCO	ATLANTA
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HORTON STEEL WORKS, LTD., Bridgeburg, Ont.; Montreal; Toronto; Winnipeg

382

HORTON

ELEVATED TANKS — FLAT-BOTTOM TANKS — GAS HOLDERS — PENSTOCKS — SURGE TANKS

Southern Pacific General Hospital, San Francisco

Railway Engineering and Maintenance

Formerly the Railway Maintenance Engineer

Vol. 21 **August, 1925** **Number 8**

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WOULD YOU LIKE TO KNOW

How the speed of a mixer affects the quality of the concrete?

How to obtain efficient delivery of chemicals for water treatment?

Why foreign railroads favor shovel tamping?

How to prepare the site for a tar-bound platform?

What maintenance employees may be expected to know about the book of rules?

Answers to these and other questions will be found in this issue.

ELMER T. HOWSON, *Editor*
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MILBURN MOORE, *Associate Editor*
DAVID A. STEEL, *Associate Editor*
H. F. LANE, *Associate Editor (Washington, D. C.)*

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In sending us change of address please be sure to send us your old address as well as the new one.

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Railway Engineering and Maintenance is a member of the Associated Business Papers (A. B. P.) and of the Allied Bureau of Circulation (A. B. C.)

HACKMANN COMBINATION TRACK LINER

SAVES 60% OF YOUR LABOR AND TOOL COST

HACKMANN Track Liners Will Line Track, Frogs, Switches, Space Ties, Raise Low Joints, Without Disturbing the Road Bed. No Digging Necessary

60% Labor Cost Saved

3 Men With Hackmann Track Liners Do the Work That Required 9 to 12 Under the Old Method Hackmann Track Liners Will Pay For Themselves By the Saving in Labor Cost

NO. 1 LINING BAR

HACKMANN COMBINATION LINING BARS

(VERONA MADE—HEAT TREATED)

The No. 1 lining bar with chisel end and the No. 2 combination tamping and lining bar are drop forged from special steel specially tempered with 1-inch drop forged lugs as an integral part of the bars, for use with Hackmann bases.

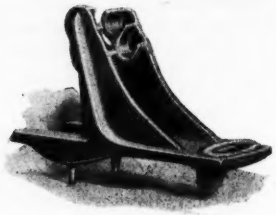
Tests on different roads have proven conclusively that the new Hackmann Combination Track Liner gives more than double the efficiency of any liner now on the market.

DEMONSTRATIONS

We Will Gladly Demonstrate the Efficiency of This Equipment Upon Request

NO. 2 TAMPING AND LINING BAR

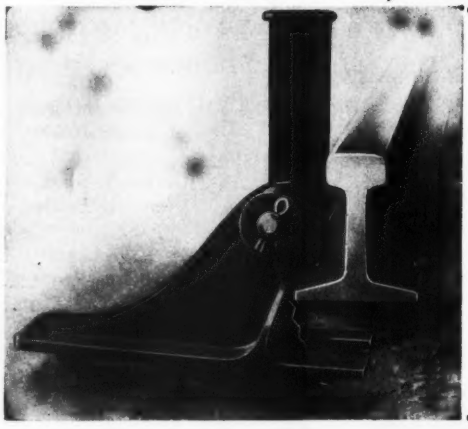
NOTE THE TWO STEP FEATURE AT TOP OF BASE



You can make at least two pulls without resetting the liner. Just move the bar to the top notch.

Weight 20 lbs.

MORE THAN 10,000 OF OUR LINERS NOW IN USE



The IDOL TRACK LINER

NOW IN USE ON 90 RAILROADS

The Idol Track Liner will line track frogs, switches, space ties, raise low joints without disturbing the road bed as no digging is necessary. They will pay for themselves every day by work you will be able to do with a few men. They will save you 50% in labor costs.

The Idol Track Liner can be operated with any ordinary lining bar.

THE HACKMANN RAILWAY SUPPLY CO.

RAILWAY SAVING DEVICES
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VERONA TOOL WORKS
New York, N. Y. Boston Mass.
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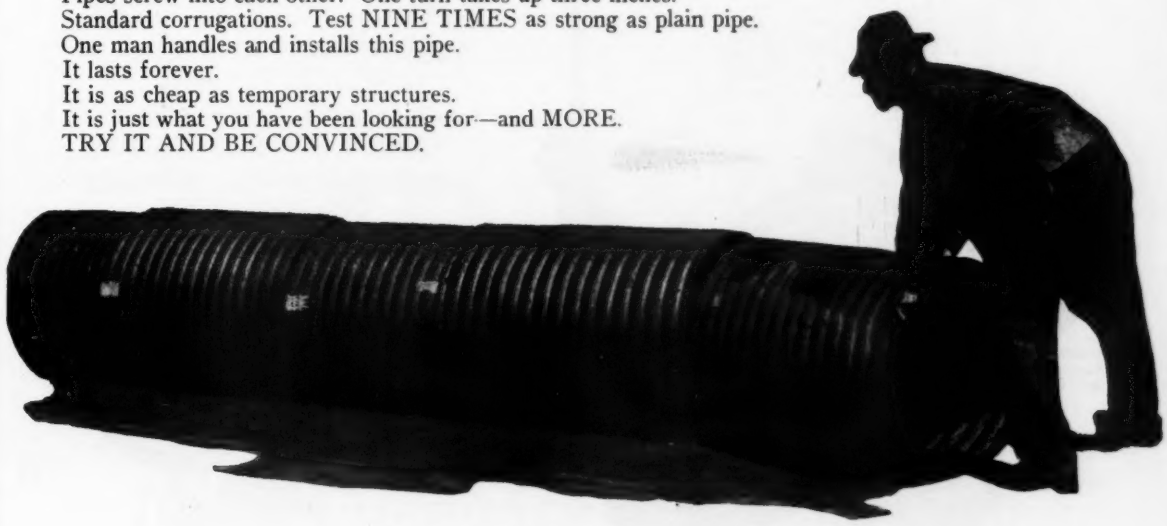
Introducing "THE MISSING LINK"

SPIRAL CORRUGATED CAST IRON CULVERT PIPE

Snappy Facts About It

Solid, round, vertically cast, pure remelted pig iron. *No scrap.*
Lengths of three feet, three inches.
Pipes screw into each other. One turn takes up three inches.
Standard corrugations. Test NINE TIMES as strong as plain pipe.
One man handles and installs this pipe.
It lasts forever.
It is as cheap as temporary structures.
It is just what you have been looking for—and MORE.
TRY IT AND BE CONVINCED.



Entering the Pipe by Rolling in on an Angle.

Screwing Pipe Together. One Turn Takes Up Three Inches

WE HAVE BEEN MAKING CAST IRON CULVERT PIPE FOR TWENTY YEARS

Write for Details and Prices

American Casting Company

Box 591 BIRMINGHAM, ALA.

RACOR

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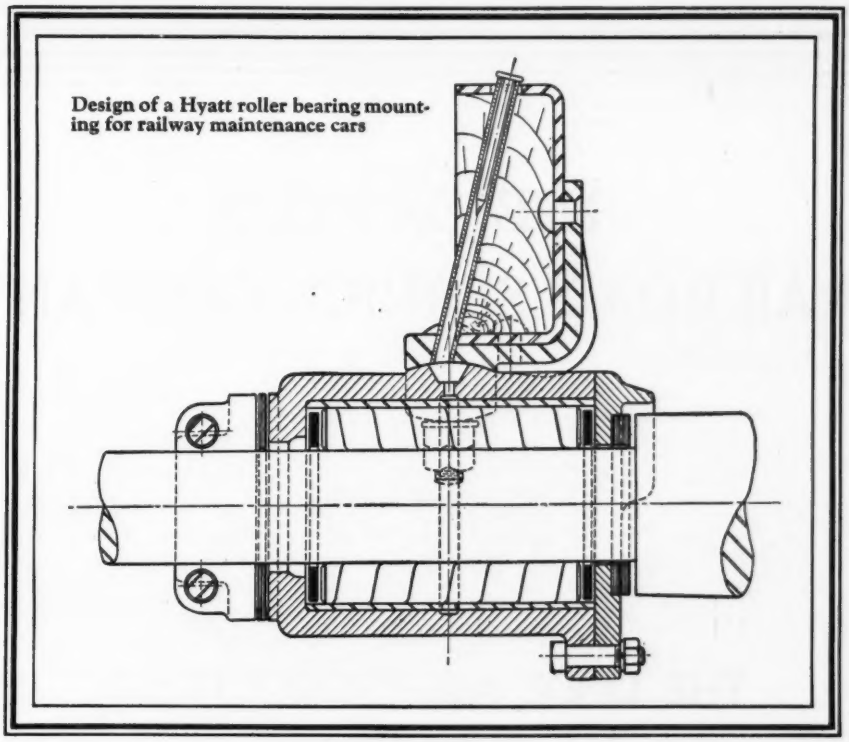


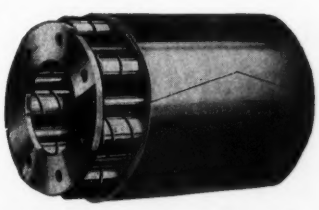
Reduce Costs—Insure Reliability *In Maintenance Car Operation*

THE cost of operating maintenance cars and the character of service rendered by them are largely dependent on one factor—the car bearings.

Leading car builders have adopted Hyatt roller bearings as best meeting the requirements of this class of service. Their uniformly easy rolling action, their positive oil-conserving lubrication and their rugged durability have proved to be a sure means to operating economies and to dependable performance under all conditions.

Hyatt equipped cars roll easily, saving fuel and man power. They are equal to the demands of hard use and overloading. The bearings require no attention other than oiling once every three or four months—no adjustments, repairs or replacements.

It is not necessary to wait until you need new cars to obtain these advantages. Hyatt bearing replacement boxes for converting your present plain bearing cars are furnished by the car builders. Ask them for complete information.



Hyatt bearings are furnished for all classes of railroad equipment. Ask for information on passenger cars, freight cars, locomotive tenders and turntables.

HYATT ROLLER BEARING COMPANY

NEWARK DETROIT CHICAGO SAN FRANCISCO
WORCESTER PHILADELPHIA CHARLOTTE
PITTSBURGH CLEVELAND

HYATT ROLLER BEARINGS FOR RAILWAY MAINTENANCE CARS

THE OXWELD RAILROAD SERVICE COMPANY

representing

THE LINDE AIR PRODUCTS CO.
(Linde Oxygen)

THE PREST-O-LITE CO., Inc.
(Prest-O-Lite Acetylene)

UNION CARBIDE SALES CO.
(Union Carbide)

OXWELD ACETYLENE CO.
(Oxweld Apparatus and Supplies)

Railway Exchange
Chicago

30 East 42d Street
New York

From the days of "Old No. 9" —*to right now*

Fairbanks-Morse was first. The first of all gasoline motor cars—a Fairbanks-Morse Car—chugged proudly over the rails in 1896. That was the first mile-post in a long succession of history-making developments in which Fairbanks-Morse was both pioneer and leader.

The first center load motor car was a Fairbanks-Morse. The first to use a water cooled engine was a Fairbanks-Morse. Fairbanks-Morse was first to employ a gear drive — first to use a chain drive — first to build a car with a free-running engine — first to build a clutch-driven car — first to employ friction drive — first to use a 2-cycle engine — first to be equipped with a brake operated by shifting the lever in either direction — first to be equipped with a pressed steel frame — first to apply auxiliary lifting handles — first (and only) to be equipped with a self-priming, easy-starting engine — first to use wood center wheels — first to use pressed steel wheels.

And Fairbanks-Morse is still first. It is merely natural that Fairbanks-Morse, having originated these high spots in motor car progress, should have also led in their later development. Today the story of Fairbanks-Morse leadership is still being written — in the first clutch that cannot be burned out used on the new "44"—in countless other "firsts" found in the wide line of motor cars, three of which are briefly described on the next page.

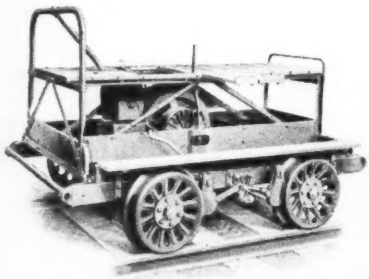
FAIRBANKS-MORSE
MOTOR CARS

First on the rails – *and still first*

A780

Each a *leader* in its class—

The Sheffield 44



Take out four bolts and the body can be lifted clear of the chassis, making every part fully accessible.

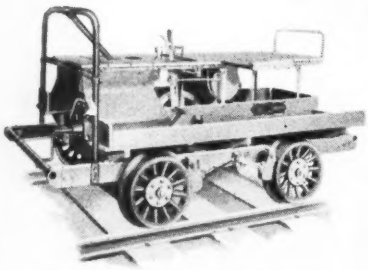
—with the clutch that won't burn out

Undoubtedly the greatest advance in one-cylinder, water-cooled motor car construction. By developing a clutch with large surfaces and cooling fins that dissipate the heat, smooth, positive control has been made possible in a chain driven car — a car that eliminates all the objectionable features of belt drive.

There is no sliding engine base to become rickety — no belt tightener — no "strong arm tactics" on the grades — no costly delays for repairing broken belts. The chain imposes a *known* tension on the crankshaft of the engine that can be *provided for* in design. Moreover, the strain is minimized by the fact that with chain drive the driving sprocket can be located *close* to the flywheel. In this way distorted crankshafts, worn bearings and similar troubles are eliminated.

Ask for descriptive bulletin.

The Sheffield 40-B



Note the rugged automobile type pressed steel frame and the wide decks with raised sills for retaining tools.

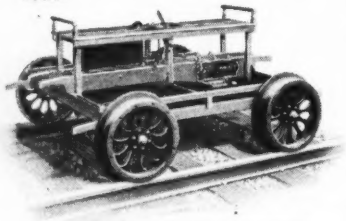
—even better than its predecessor

Nothing need be added to that statement for those who are familiar with the predecessor of this car — the famous Sheffield 40.

In the new 40-B absolute rigidity is made a certainty by the use of a new, automobile type pressed steel frame — probably the strongest ever used for a car of this type. The two-cylinder, air-cooled engine has been still more highly refined. The crankshaft is mounted on Timken Bearings which absorb the thrust of the greatly simplified friction transmission. Three-point suspension insures perfect alignment.

Ask for bulletin information.

The Sheffield 41



A light, center load inspection car. The ideal car for roadmasters, supervisors, signalmen, linemen, etc. — the car that starts with a short push even in the coldest weather, as a result of the Fairbanks-Morse automatic primer. The lightest car of its strength ever built. Weight only 460 pounds. Speed 25 miles per hour in either direction. Unmatched for economical operation and low maintenance.

Ask for bulletin.

Coaling Stations

The finest of equipment backed by undivided responsibility permanently guarantees every coaling station that is

Built throughout by

FAIRBANKS-MORSE

FAIRBANKS-MORSE & CO., Chicago

Manufacturers of railway motor cars, hand cars, push cars, velocipedes, standpipes for water and oil, tank fixtures, oil engines; steam, power and centrifugal pumps; scales, and complete coaling stations.

24 branches in the United States, each with a service station

FAIRBANKS-MORSE
MOTOR CARS

First on the rails – *and still first*

ARMCO Culverts in Railway Service

No. 21 of a Series

Name of Railway: Chicago Great Western.

Location: Main Line Chgo. & Mpls. to Omaha.

Traffic: Average passenger and freight.

Installation Data: 12 Ga., 36″ ARMCO Culvert 108 feet long, installed 1910 or 1911, under approximately 22′ fill of clay soil.

Condition: Excellent. Inspected and photographed Jan. 10, 1922.

Remarks: The elasticity of ARMCO Culverts permits carrying the pipe beyond the embankment, preventing erosion at the toe of slope, as shown in the installation above.

There is a manufacturer in almost every state and in Canada, making Culverts, Flumes, Siphons, Tanks, Roofing, etc., of genuine, rust-resisting Armco Ingot Iron. Write for full information and nearest shipping point on products in which you are interested

ARMCO Ingot Iron

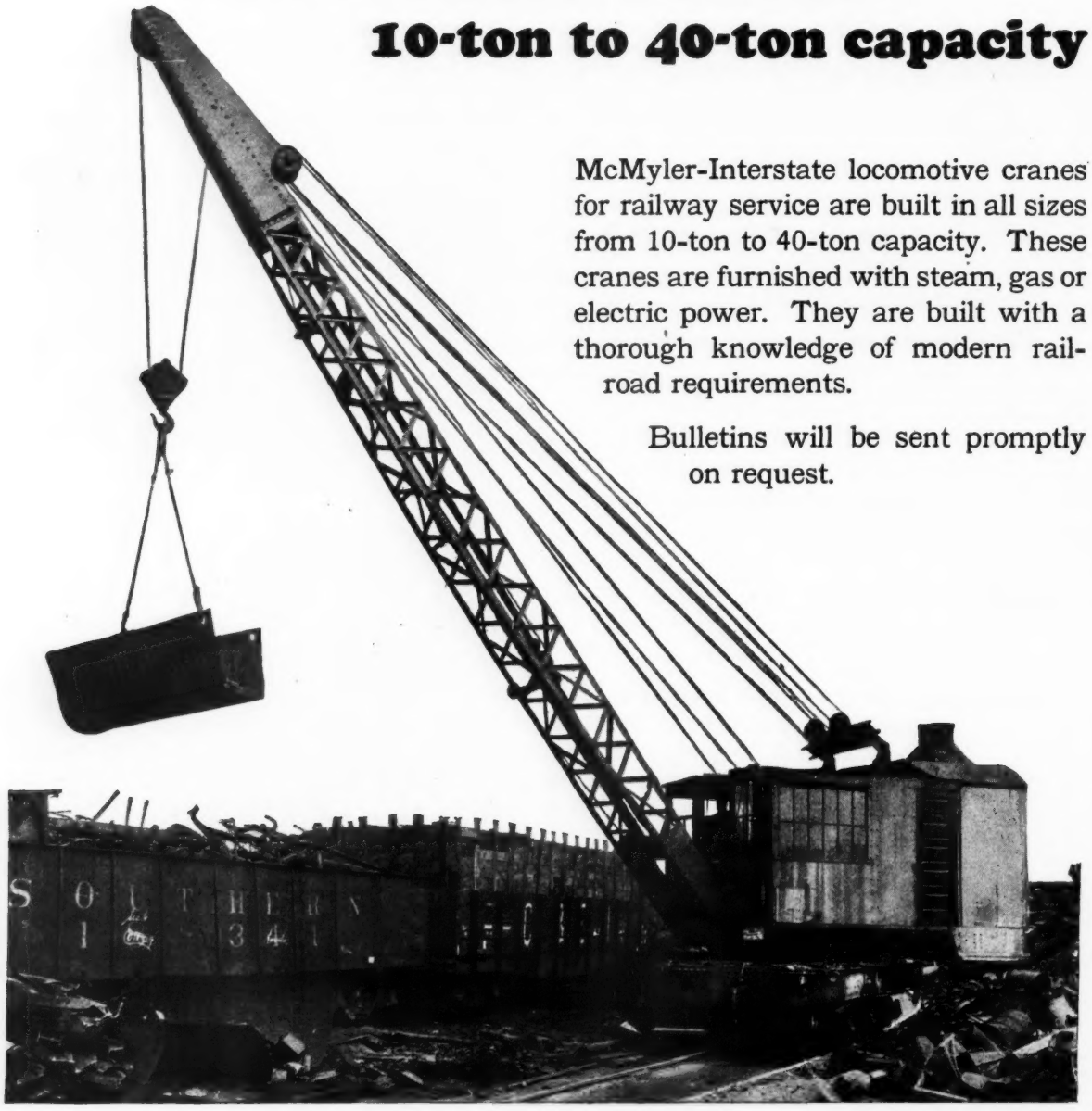
ARMCO CULVERT & FLUME MFRS. ASS'N, Middletown, Ohio

ARMCO CULVERTS

McMyler-Interstate

Locomotive Cranes

10-ton to 40-ton capacity



McMyler-Interstate locomotive cranes for railway service are built in all sizes from 10-ton to 40-ton capacity. These cranes are furnished with steam, gas or electric power. They are built with a thorough knowledge of modern railroad requirements.

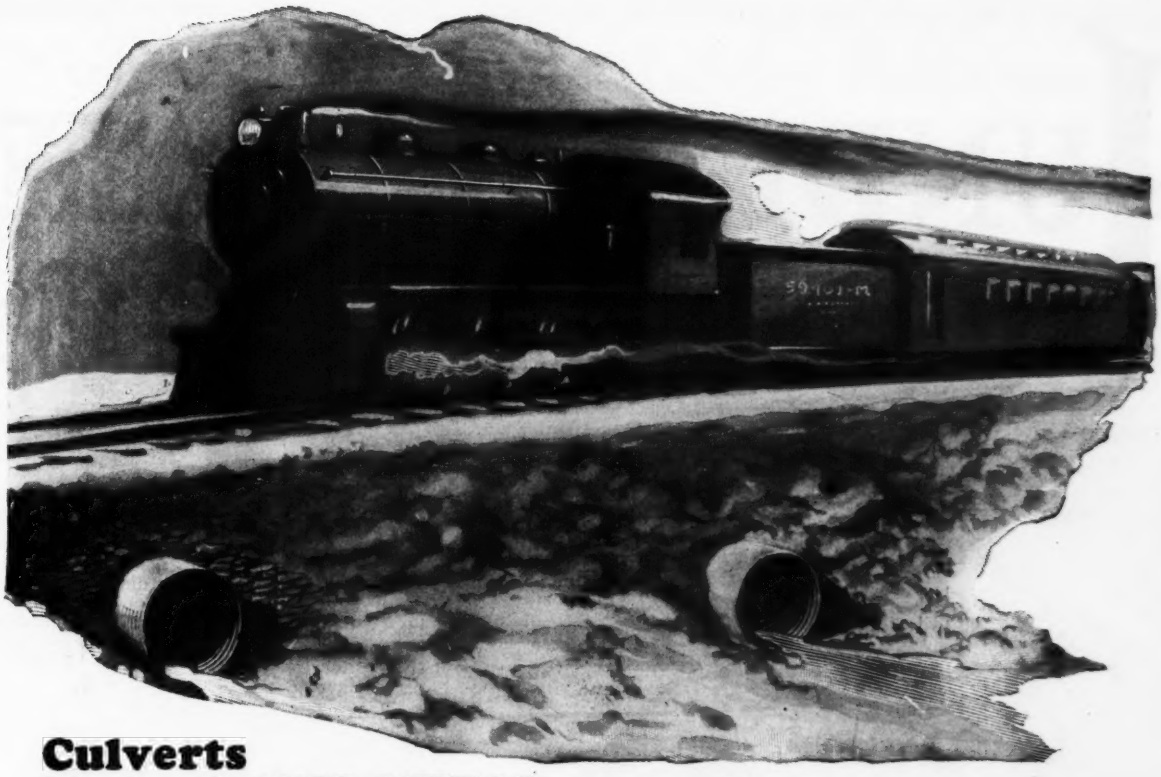
Bulletins will be sent promptly on request.

C-4-12

Steam Shovels · Gas Shovels · Locomotive Cranes · Clam-shell Buckets

McMyler-Interstate

NEW YORK BUFFALO · PHILADELPHIA PITTSBURGH · **CLEVELAND** · DETROIT CHICAGO · SAN FRANCISCO LOS ANGELES



Culverts
Made of OHIO METAL [Copper Steel]
Hand Dipped in Pure Zinc AFTER Forming

The new Wheeling process of hand dipping culverts after they are fully formed, makes it possible to get out of pure zinc every ounce of protection to the base metal that pure zinc is capable of providing.

The zinc coating on Wheeling Hand Dipped Culverts protects! It leaves not even the smallest part of the steel exposed, not even the edges which are coated the same as the surfaces.

Zinc coatings on culverts made from galvanized steel sheets must necessarily be light to prevent fracture when sheets are put through corrugating machines. However carefully the sheets are corrugated it is possible to see the damage to the coating with the naked eye.

Wheeling Hand Dipped Culverts are coated *after they are formed,* just as a house is painted after it is built. There is no possible manner in which the coating, the heaviest ever obtained for culvert protection, can be marred or fractured. Coatings of 3.50 ounces per square foot and upward are obtainable, with a base of rust-resistant copper-bearing steel, insuring the maximum durability and long life.

Secure prices on Wheeling Hand Dipped Culverts before you buy. Write the nearest warehouse or direct to

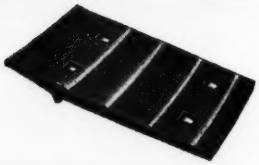
WHEELING CORRUGATING COMPANY, Wheeling, W. Va.

New York Chicago Philadelphia St. Louis
Kansas City Richmond Chattanooga Minneapolis

Wheeling
HAND DIPPED CULVERTS

LUNDIE TIE PLATE

Prevents cutting of a single fibre of the tie



TIE protection against mechanical wear depends entirely upon the type of tie plate used.

Money spent on costly treated ties is lost when the cutting ribs of ordinary tie plates eventually break down the wood fibers allowing moisture to go below the safety line of penetration. Premature decay then prevents the treated tie from delivering its full return on the investment.

By scientific design the Lundie Tie Plate develops beneath the plate a hardened wear-resisting surface that assures absolute tie protection under the heavest traffic conditions.

It is this tie conservation and fewer replacements that bring to railroads substantial savings in maintenance cost. This sound basis of ultimate economy each year is influencing more roads in their choice of the Lundie Tie Plate.

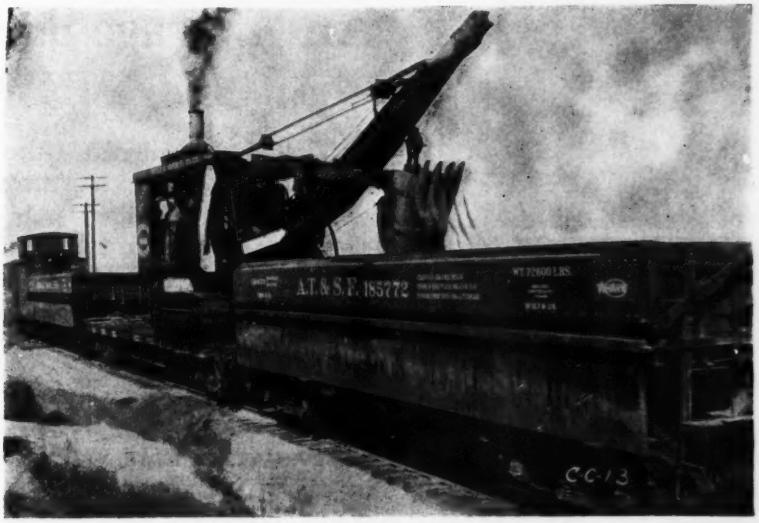
The Lundie Engineering Corporation
920 Broadway, New York
166 West Jackson Boulevard, Chicago

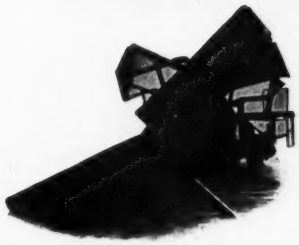
LUNDIE DUPLEX RAIL ANCHOR

Tie Plates That Protect

Note remarkable surface protection on illustrated tie after 8½ years under the heaviest traffic conditions.

Western Dump Cars in Railway Maintenance





All We Ask Is a Chance to "Show You"

Let us refer you to railroads who are saving labor and money by using these superb Western Air Dump Cars equipped with the Western Extension Floor or Apron. Look for the facts and when you have found them you will install Westerns.

WE want to "show you" that—

Western Air Dump Cars will pay for themselves compared with unloading plow methods.

Being air operated they require a minimum of men on the dump.

They are always ready to be dumped either way instantly.

They can do their work and dodge traffic.

They may be equipped with aprons for throwing the load beyond the ballast.

Railroad contractors almost invariably install Western dump cars for construction work. They have learned from experience that they can make more money with Westerns. May we show you how Western Air Dump Cars will speed up railroad maintenance, saving time, labor and money?

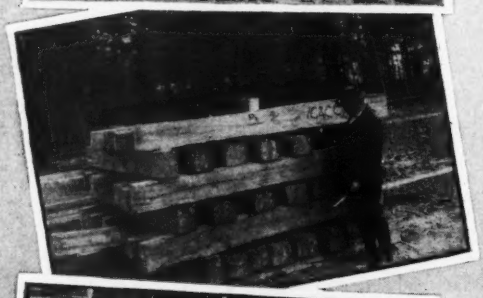
Write today for Catalog M-61

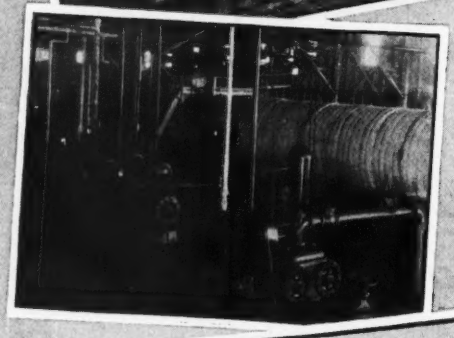
Western Wheeled Scraper Company

Founded 1877

Earth and Stone Handling Equipment

AURORA, ILLINOIS





An Average Tie Life of Over 20 Years

THREE big railroads—the Santa Fe, the Chicago & Northwestern and the Lehigh Valley have published their records of annual tie renewals. Each showed an average tie life of over twenty years. You can remember when ties on many railroads averaged lower than ten years' life!

But now treatment of ties with chemical preservatives has become general, and this marked increase in life is the direct result. Science is paying these railroads an annual dividend.

Treated ties are the answer to your biggest maintenance problem. Two things are vital: ***Good Timber*** and ***Good Treatment.*** ***International*** offers you both, and in addition a service that is unexcelled.

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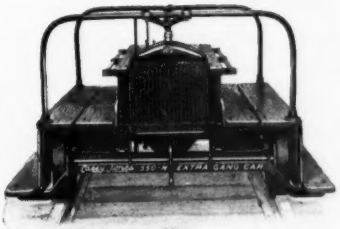
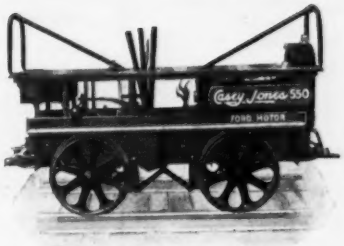
Casey Jones 550

Heavy Duty Railway Motor Car

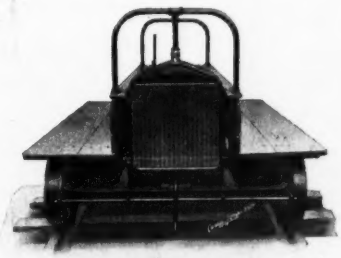


Casey Jones 550 H. Hump and Extra Gang Car

Standard Ford Motor



Casey Jones 550 Heavy Duty Motor Car—Standard Model



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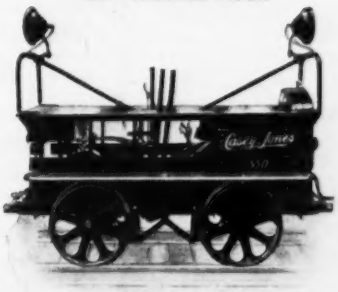

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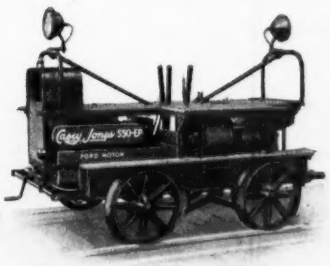
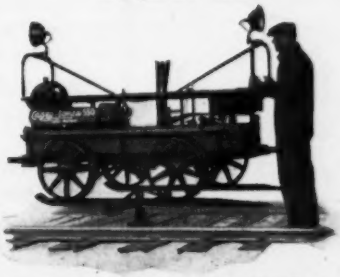
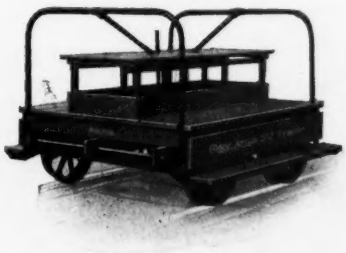


Casey Jones 550 E. P. Electric Power Car—7½ K. W. Generator



Turntable H. D. X. for Handling Large Motor Cars



Casey Jones 552 Heavy Duty Trailer For Large Gangs

SPECIFY Casey Jones An investment in permanent satisfaction

Casey Jones 550T with Full Enclosed Top

NORTHWESTERN MOTOR COMPANY, Eau Claire, Wis., U. S. A.

Du Pont chemical engineers insure uniformity of quality by chemical control through every step of manufacture from raw material to finished product.

Uniformity of Production Is a Safety Factor in the Use of Explosives

YOU can assure yourself and also your employes of greater safety by the use of du Pont explosives.

In the manufacture of explosives, the du Pont Company employs the most exacting methods to obtain a uniform production. As a result, its explosives accomplish complete detonation, cause an increase in production and eliminate the dangers attending a partial detonation. Specifying du Pont explosives is another way to apply safety methods to hazardous operations.

The du Pont "oval" signifies uniformity, dependability and stability of explosives,—a combination of qualities which are safety factors in blasting operations.

Blast with du Pont powders

There is a du Pont explosive to meet every blasting need—to do *your* particular work *best* at *least* expense. For contracting we especially recommend:

Red Cross Extra Dynamite: 20% to 60% strength; low freezing; fairly water-resisting; heaving and lifting action.

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Du Pont blasting powder is the most widely used low explosive. It is regarded as standard everywhere. Every keg bears the orange band.

Du Pont Blasting accessories give you maximum efficiency from your explosives. Make every shot *sure*—protect your blasting investment by using only du Pont accessories.

For further information about du Pont explosives and blasting accessories, please refer to "Roads and Streets Catalog"—or write to our nearest office.

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STOP !
LOOK !
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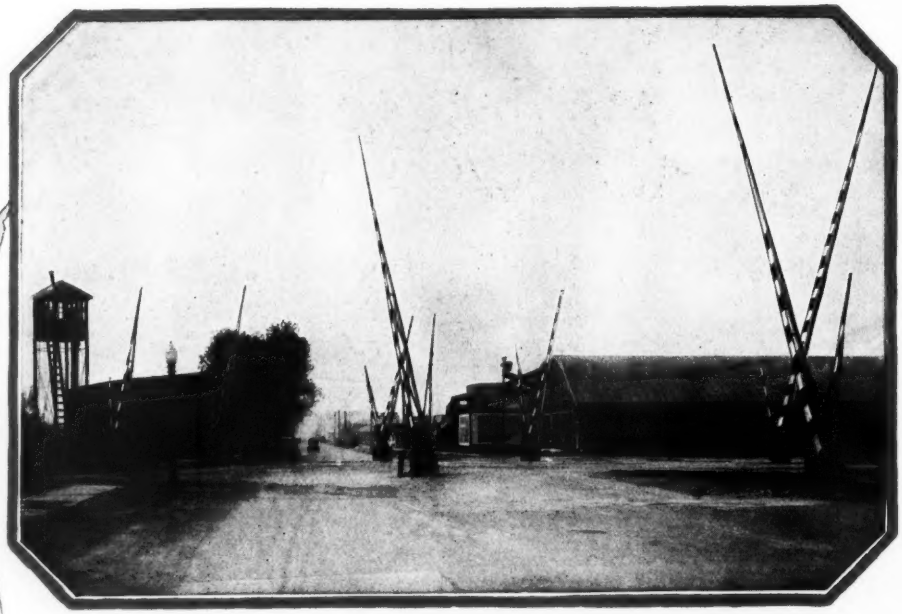
ESTABLISHED
1881



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Buda Safety Crossing Gates have been developed in every detail to the highest efficiency for every requirement of modern practice.

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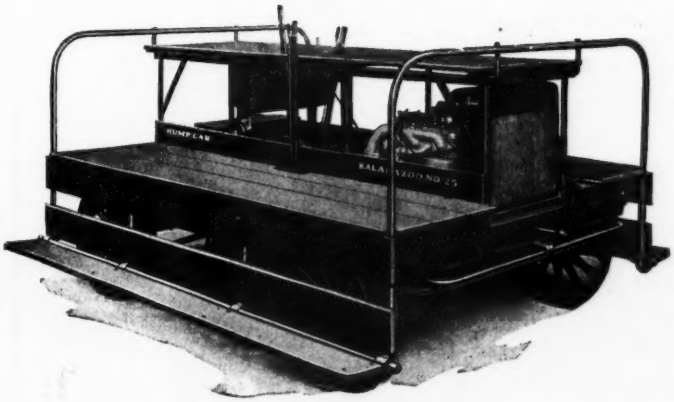
KALAMAZOO

MODERN RAILWAY SERVICE DEMANDS THE BEST IN MOTOR CARS



Kalamazoo No. 25 Hump Car

The KALAMAZOO No. 25

HAS STOOD THE TEST

SAFE—STURDY—RELIABLE

We have accurate records of Kalamazoo No. 25 Motor Cars that have been in operation from 150,000 to 200,000 miles and are still in service.

The Kalamazoo No. 25 Motor Car which we have been building for the past ten years, embodies all the latest improvements in automotive engineering and records prove that the car actually pays for itself in a short time under the most severe operating conditions.

Actual photograph of Kalamazoo No. 25 Motor Car with Kalamazoo Trailers in extra Gang service.

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CABLE ADDRESS "VELOCIPEDE"

Why the Men Prefer Jackson Electric Tie Tampers

Here are a few outstanding reasons why track men prefer the Jackson Electric Tie Tamper.

It is easy to handle
(Less exertion and manual labor required to operate than a tamping bar or pick)

It is simple to operate
(No complicated parts to get out of order)

It is convenient to use
(Shaped to tamp in the right direction, under the tie)

It does not jar the operator
(The blow is all against the ballast)

The Power Plant requires no special foundation
(Can be set down anywhere along the track)

It is portable
(Enabling quick advancement along the track)

A demonstration will convince you.

ELECTRIC TAMPER & EQUIPMENT CO.
Railway Exchange **Chicago, Ill.**

Equip Your Work Trains With Extension Side Dump Cars

THE down turning door of the Extension Side Dump Car permits the instantaneous dumping of any kind of a load from fine sand to the largest boulder. This feature is vitally important in work train service, especially when it is necessary to carry on heavy operations upon the right-of-way and dumping completed between train time.

You can depend always upon the quick action of these cars. The movement of the body to full dumped position is a positive rolling motion without excessive shock. As the car body tips, the side goes out and down and the load is sure to go. There is absolutely no danger of materials wedging, causing delays in releasing the cars.

The Extension Side Dump Car has a proved record of success in cinder service, ditcher service, bank widening, rip-rapping, bridge filling and general construction work.

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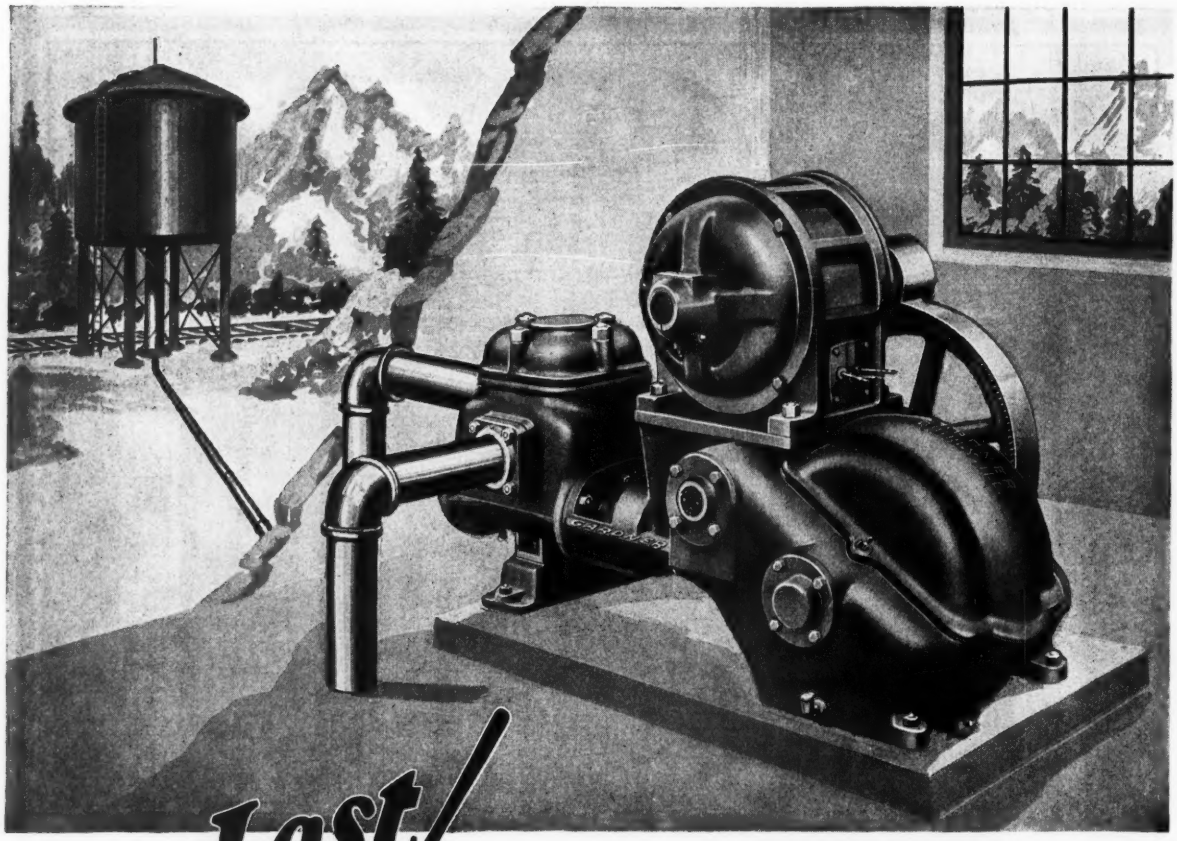
Extension Side Dump Cars
— Air Operated —



At Last! AN IDEAL REMOTE-CONTROL PUMP FOR RAILWAY SERVICE

Because it is self-lubricating and highly perfected in every mechanical detail, this new GARDNER Pump may be located at any distance from the water tank, operated by an electric switch, and visited only once a month.

All parts are flood-lubricated like an automobile motor, so that oiling is required only once a month. Figure the time and trouble saved as compared with pumps requiring daily attention. Patents pending. Write today for Bulletin EP-I.

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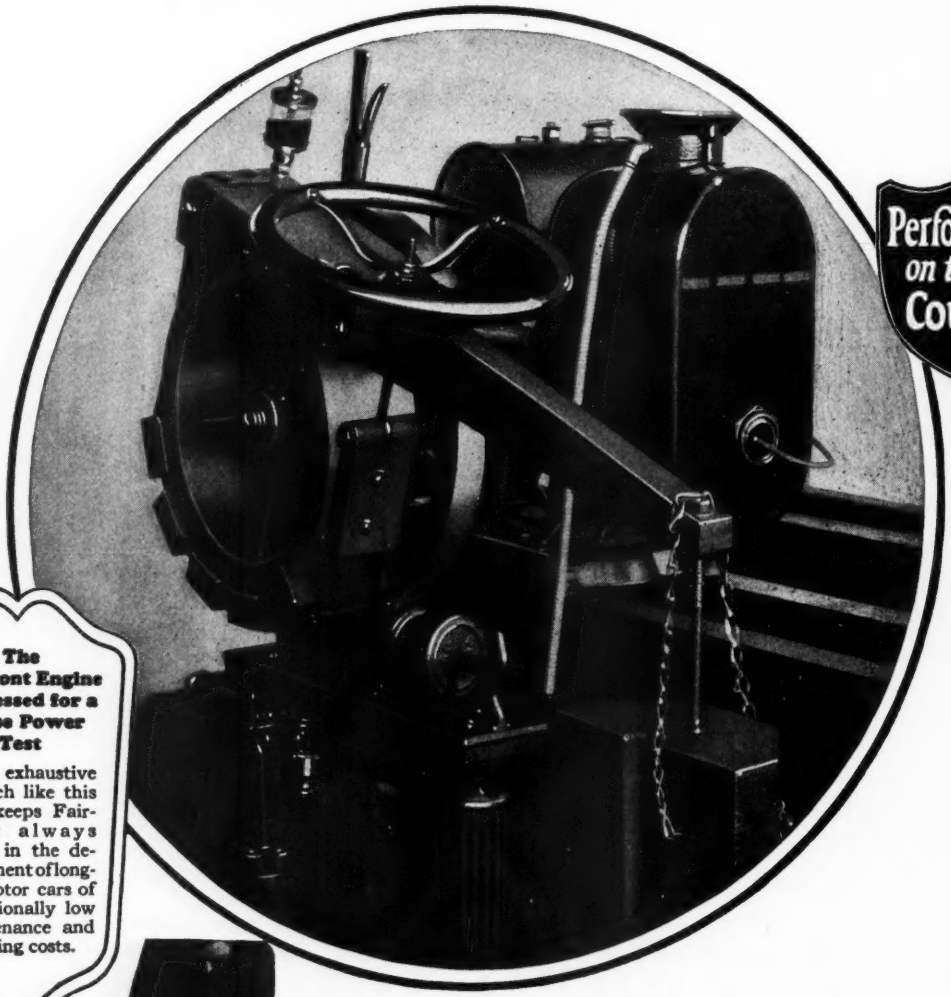
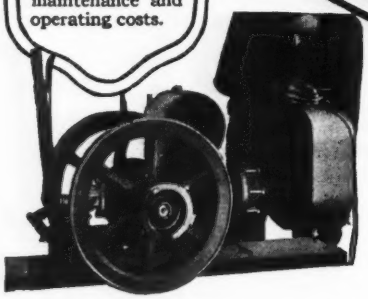


Performance *on the Job* Counts

The Fairmont Engine Harnessed for a Horse Power Test

It is exhaustive research like this that keeps Fairmont always ahead in the development of long-life motor cars of exceptionally low maintenance and operating costs.



The Fairmont Water-Cooled Freeze-Proof ENGINES

The Water-Cooling System of the engine, which eliminates destructive over-heating is one of the many practical and highly desirable Fairmont features. It saves oil, saves fuel, saves working parts—is a prime factor of Fairmont DOMINATION.

Maintaining the Lead— Through Anticipating the Need

Everlastingly alert Fairmont continues to lead.

Fairmont Engineers watching closely the trend of users' requirements are first to foresee new needs and develop equipment which will meet them with maximum efficiency and economy.

Which is one of many reasons why more than half of all track motor cars made each year bear the name FAIRMONT.

FAIRMONT RAILWAY MOTORS, Inc.
Fairmont, Minnesota

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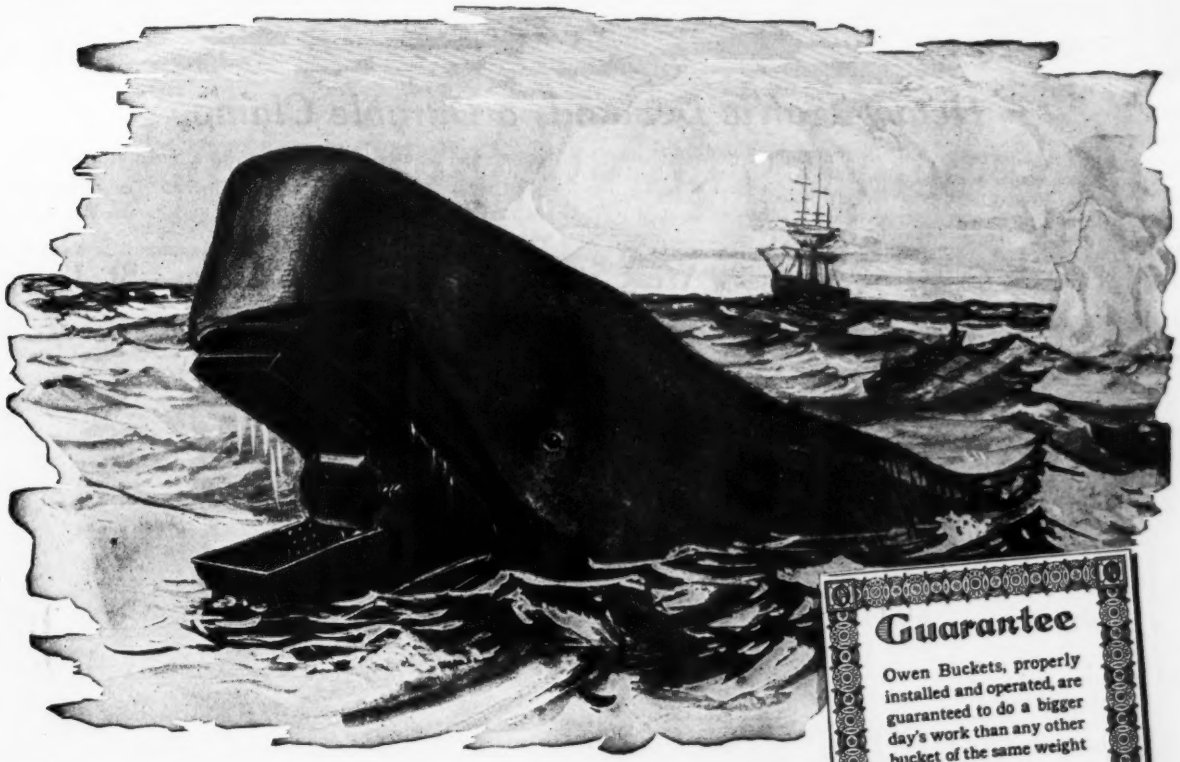
Fairmont

Ball Bearing Motors and Railway Motor Cars



Guarantee

Owen Buckets, properly installed and operated, are guaranteed to do a bigger day's work than any other bucket of the same weight and capacity—

—or—

Write your own guarantee!

THE OWEN BUCKET CO.

A Mouthful at Every Bite

The whale's mighty jaws, backed by the tremendous strength in his huge body, close over a heaping mouthful at every bite. Rarely, indeed, does the mammal king only "skim the surface" in his ponderous rush. He goes after his mouthful with the same determination that has marked the survival of the whale through eons of time during which weaker water giants faded into oblivion.

The whale and an Owen Bucket—jaws of irresistible force, terrific body strength—that mouthful at every bite. But unlike the water creature, an Owen Bucket is quick in action and possesses the outstanding capacity for "digging in." An Owen Bucket insures larger loads, greater profits and most economy in operation.

We want you to know more about Owen Buckets—their strong and sturdy construction, their adaptability, their earning power—and how, by their nine points in superior construction, they mean a "whale" of a saving in your digging dollars. Send for Folder "2-A." It tells the story.

The OWEN BUCKET Co.

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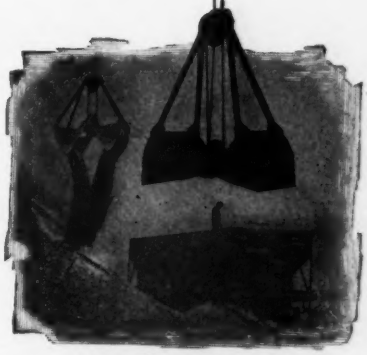

A Type "J" Owen Re-handling Bucket of one yard capacity unloading 2" crushed slag for Ohio Coal and Supply Co., Cleveland.

OWEN CLAMSHELL BUCKETS INSURE A BIGGER DAY'S WORK

Owen Buckets

INSURE A BIGGER DAY'S WORK

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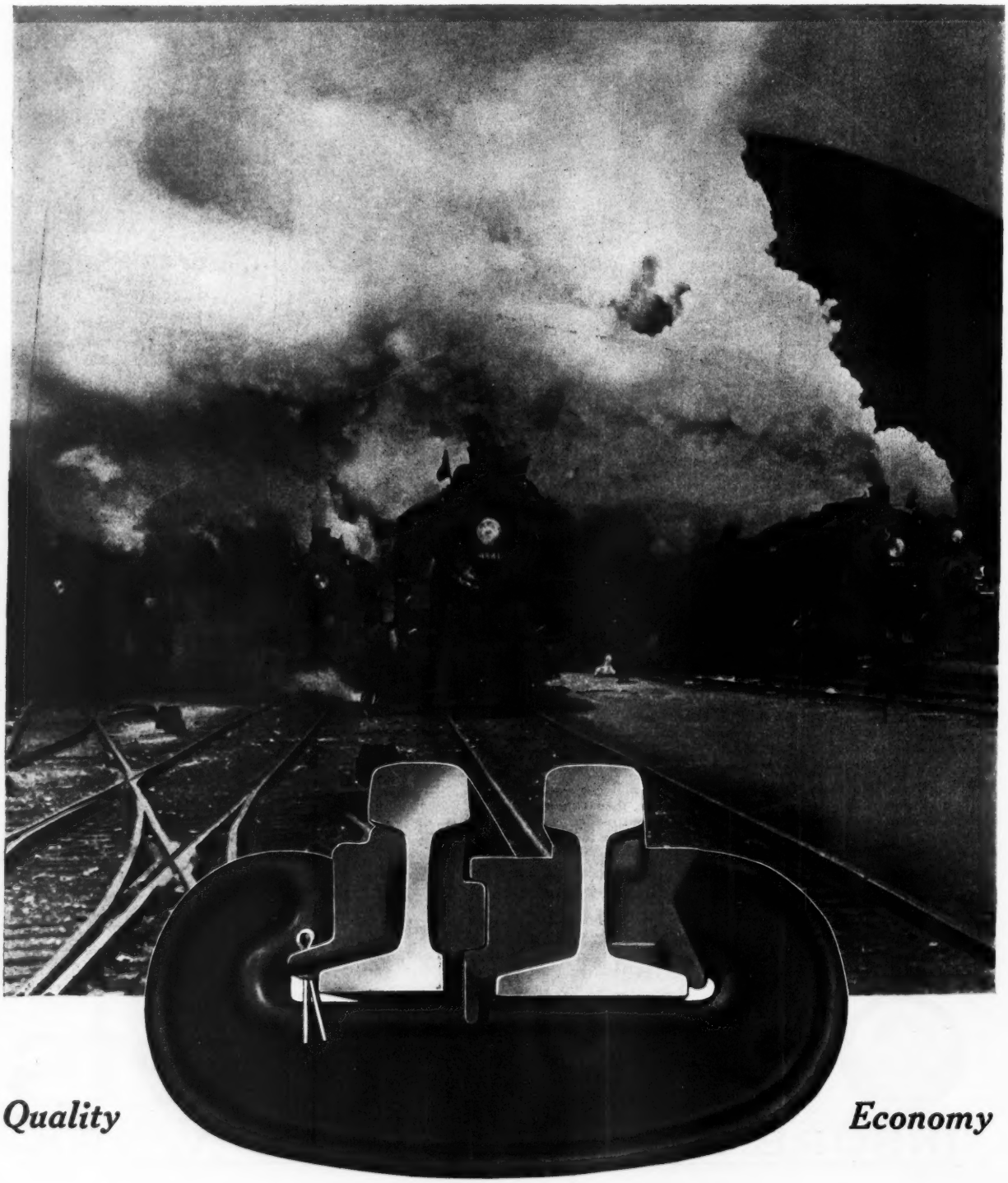
Heavy Traffic Demands a Durable Clamp

The Q & C Universal Guard Rail Clamp assures a reliable performance under all traffic conditions.

The drop forged yoke is reinforced with an "I" beam construction and there are no grooves or keyways to weaken it. This gives maximum strength, eliminates excessive maintenance and assures your frog point protection at all times.

They are made in various sizes for all Tee rails. Our engineering department will be glad to forward blue prints and any other information requested.

THE Q & C COMPANY, 90 West Street, New York—Chicago—St. Louis



Quality *Economy*

Railway Engineering and Maintenance

Volume 21 July, 1925 Number 7

"ABOUT HALF OF THEM"

A VISITOR who was being shown through a large factory and who inquired casually how many men worked there, was struck with the frankness of his guide when he replied "About half of them." The same reply might well be made to a similar question regarding not a few maintenance of way gangs. It will be worth the while of a supervisory officer to observe his gangs, large and small, to see how much of the time of the various members is wasted. Under the universal method of payment of maintenance of way forces, a workman is paid for his time. It therefore belongs to the company and it has a right to expect that the men shall expend this time in its behalf.

A campaign to reduce wasted time will be resented by many of the men, the degree of their resentment being a fairly accurate indication of their efficiency. It is not suggested that insistence on a man's constant application to his work should be carried to the point of working a hardship on him, but at the present time when there is a surplus of men in most communities, it is not entirely out of place for a road to endeavor to take up some of the slack and to allow those men to leave the service who are not willing to follow the pace which other men are willing to undertake.

Many comments have been made in recent years regarding the high wages paid by a large manufacturer who has recently entered the railway field, but when it is recognized that this wage rate goes only to men who are willing to conform to the working methods imposed by his company and that these methods require constant adherence to duty, the rate is little above and in many cases probably actually below that paid on other roads, based on the amount of work produced. This is the final test of any wage.

THE NEED FOR INFORMATION

THE RAILWAYS of the United States and Canada are slowly but steadily adopting a heavier track construction. The 66-lb. and 75-lb. rail have given way in large measure to the 85-lb. and 90-lb. rail and they in turn are now being replaced by the 110-lb. and 130-lb. and 136-lb. sections on the more important main lines. Is this added expenditure warranted? If so, how are the benefits reflected? Are they evidenced in reduced costs of maintenance and if so, have any men been laid off or has this benefit been realized in the development of a higher standard of maintenance? If the latter, is this standard warranted by the traffic? These are some of the questions which a railway management has a right to ask and which a maintenance officer should be able to answer when advocating increased expenditures for heavier rail or for more or improved track fastenings, etc. In fact, he should utilize every opportunity to gather this information for his own use whether his management requires it or not. He should have it available not only to back up his recommendations but also to aid him in determining the recommendations themselves. Largely increased expenditures are made all too frequently on judgment unsupported by data. As a result errors are made, both of commission and omission.

As an illustration of the value of information of this character the chief engineer of a road which has long pioneered in the development of a strong track construction and has spent large sums of money for this purpose, showed recently by a comparison of the amounts spent for maintenance on his road and on neighboring lines of similar traffic and physical characteristics that the ratio of his total expenditures for maintenance to total operating expenses was several points below the others and that if he had spent the same percentage as the average of his neighbors his cost would have been more than three million greater than it actually was. His conclusion was that this result was proof of the return which was accruing to his road from expenditures which it had made over a period of years for the strengthening of its track. This conclusion was supported by the fact that the two roads which approached his record most closely were roads which had spent similarly large sums for the improvement of their track. In other words, this study not only vindicated the judgment of the engineering and executive officers of these roads when they authorized these expenditures, but it demonstrated the fact that the average railroad can spend much money for the strengthening of its busy main track with economy.

THE CONCRETE FOREMAN NEEDS HELP

IT HAS BEEN said that the morale of the army is proportionate to the calibre of its "top sergeants." It is no less agreed that the morale of a civil organization depends upon its foremen. The value of the sergeant lies in the fact that he is a naturaal leader and that he is thoroughly versed in the art of being a soldier. So in any line of work the value of the foreman lies in his ability as a leader and his own personal knowledge and skill in the craft.

In the older trades, such as blacksmithing, bricklaying and carpentry, good workmanship is assured if a good foreman is employed because an apprenticeship and experience under other good foremen have taught him what good workmanship is and how it is obtained, and he will demand it of his men. This fortunate state of affairs does not prevail with respect to the making of concrete. Concrete making is a relatively new art. Rules for good workmanship are still subject to change and instead of a system of established practices which have passed from

one workman to another through generations we find that the methods of making concrete are still being revised from time to time on the basis of scientific study and that the new methods are promulgated by means of the printed page rather than through the aid of the human contact of craftsmen and apprentices.

There are other reasons why knowledge of the making of concrete is not readily disseminated. Concrete is made by machinery with the aid of common labor and it does not involve so much of the detailed hand work of individual workmen skilled in the craft. Moreover, the mixing of concrete is a complex manufacturing process in which the relation between practice and the character of the finished product is not so readily discernible as it is in a trade in which the skill of the workman is evident by the nature of the work he turns out from hour to hour.

In general, therefore, it may be said that while the average concrete foreman is doing his best to obtain good results, he is working under a serious handicap and it is not to be expected that the work which he turns out will measure up to the possibilities as to strength and high quality which are attainable if the concreting is done in accordance with rules based on the best information available today. As pointed out in the article by A. M. Bouillon, objectionable practices continue to creep into much of the concrete work that is done and today it is not always that the reasons why the practices are objectionable are entirely obvious. In order, therefore, that foremen may have every opportunity to obtain the best results in their work they should receive the benefit of the advice and counsel of their superiors whose training and education have enabled them to keep more nearly abreast with current developments in this special field.

A CENTURY OF DEVELOPMENT

When George Stephenson's locomotive made its initial trip with a train on the Stockton and Darlington railway in England on September 27, 1825, thus inaugurating the era of steam transportation, so little importance was attached to it that the newspapers of that day made no mention of it. Yet no event has affected the economic history of the world more profoundly.

The railway has been in the vanguard of civilization since that time. It has made possible the most rapid settlement of new lands. It has transformed the civilized nations from small, self-contained communities into prosperous commonwealths.

The transportation that has made American development possible has at the same time made itself an economic necessity. Our highly complicated industrial and civic life has come into being only through the free movement of people and of products from one community to another. Because of this intimate relation of railway transportation to national life and prosperity it is necessary that the railroads be operated with the maximum efficiency. The development during the first century of railway transportation has been marvelous. There is no reason to believe that this development will not continue during the next century.

LEARNING FROM OTHERS

WE ARE devoting considerable space in this issue to abstracts of papers describing maintenance of way practices throughout the world, which were presented before the International Railway Congress in London late in June. We have done this because of the interest which we believe that railway men will take in the practices in vogue in other countries. While men in America are familiar with the practices followed here, we have also presented Mr. Ray's summary of American standards in order that comparisons between the practices followed here and those in effect on railroads in other parts of the world may be contrasted more readily.

A study of the practices of other countries shows that while methods vary widely in detail they also have many points of similarity. Thus, the shorter working day, the necessity for the increasing use of labor saving equipment and the growing refinement of maintenance practices are universally evident. In other respects, methods differ and American railway officers can well afford to weigh these departures from the practices followed in the United States and Canada to see whether they cannot find some suggestions of value in the experience of foreign railways.

One difference which stands out prominently between American and European practices is the extent to which material is conserved abroad. An average life of 25 to 30 years for rail on the main lines of France contrasts with a life of less than one-half that in this country, while they secure from 25 to 30 years from treated hard wood ties whereas we have only recently considered it worth while to treat hard wood in this country and our average life of ties (treated and untreated) probably does not exceed ten years at present. It must be recognized, of course, that the vastly heavier wheel loads in this country affect these figures, but no small part of this difference is due to a lack of adequate protection of these materials from unnecessary abuse. Measures of this character are more commonly found on railways of Europe than here.

Another subject worthy of consideration is the attention given to the training of men for subordinate supervisory positions on a number of foreign roads, whereas this subject has received relatively little attention in this country in spite of the almost universal complaint regarding the shortage of men of adequate ability for appointment to these positions. Several foreign roads have well developed methods of training men with the result that they have at all times an adequate number of men prepared for these positions as they develop.

American railway men can learn much from the experience of men similarly employed on foreign railroads. Those men and those roads progress most rapidly which draw most freely from the experience of others to supplement that gained by themselves.

ARE THE RAILWAYS RETRENCHING?

THE COMMENT has been heard frequently during recent weeks, particularly among railway supply men, that the railroads are retrenching this year and that they are not buying the normal quantities of engineering and maintenance of way materials. Do the facts bear out this impression or is it erroneous and born of a desire for more business? To confirm or correct this impression one need only turn to the statistics compiled by the Interstate Commerce Commission.

These statistics are now available for the first five months of 1925 or to June 1. The figures for 191 roads show that while railway operating revenues in this

five months' period declined from $2,406,675,576 in 1924 to $2,388,417,735 this year and while all railway operating expenses decreased from $1,910,038,738 to $1,862,933,249, expenditures for maintenance of way *increased* from $311,248,335 to $313,550,560. In other words, while there has been a slight decrease in all expenditures, those for maintenance of way actually *increased*. In view of the gradual decline which has occurred in the average prices of materials and still more of the improvement of labor conditions whereby greater returns are secured from the men in service, it is to be expected that the *quantities* of materials and supplies actually bought is in somewhat greater proportion than even these relative expenditures would indicate.

There is also another consideration to be taken into account. Of late there has been an increasing tendency to do more work during the winter. This requires that the materials needed for these operations must be procured in the fall. Any materials purchased at this time will obviously not appear on the books of manufacturers the following spring and comparisons with the early months of previous years are inaccurate to that extent. In large part the books of those companies which are reporting a falling off in business during the first half of 1925 will be found to have shown increases in the latter months of 1925. In other words, they received their orders six months ahead of the time they have been accustomed to. Because of this fact and in the light of the expenditures referred to above it is evident that the roads as a whole are not only not retrenching but are actually spending more money for maintenance than they did last year.

VOLUNTARY EXAMINATIONS OF EMPLOYEES

ANY MAN who has taken a correspondence course of study, if he is really honest with himself, realizes that the value of the course to him is measured by the amount of work he puts into it. He may feel, therefore, that the formal examinations which he is required to take during the course of his study are in the nature of a formality whose chief function is to add a certain amount of dignity to the course of study. He loses sight of the fact that an examination functions as a sort of spur to the student, causing him to correlate his knowledge of the subject in such a way that the information which he is most likely to need will be thoroughly impressed on his memory. It was this law of psychology, no doubt, which led the officers of the Nashville, Chattanooga & St. Louis to institute a system of examinations of the employees in the maintenance of way department in the rules governing the conduct of the work. They knew that a man could read a book of rules from cover to cover and yet do it in such a perfuctory way that he would get almost nothing out of it, but that if he knew that he was going to be asked some questions relating to the book, the manner of his reading it would be entirely different. It would mean that he must not only read, but actually rehearse what he has read.

However, in setting up the system of examinations, the plan adopted was founded on the principle that the good to be secured from the examinations lies primarily in the mental training of the employees rather than in the knowledge gained by the officers of the railroad with respect to the proficiency of the various employees in the book of rules. For this reason, the examination was made entirely optional on the part of the employees. No one is required to take the examination unless he wishes to do so. In other words, it is a method of helping those who wish to help themselves.

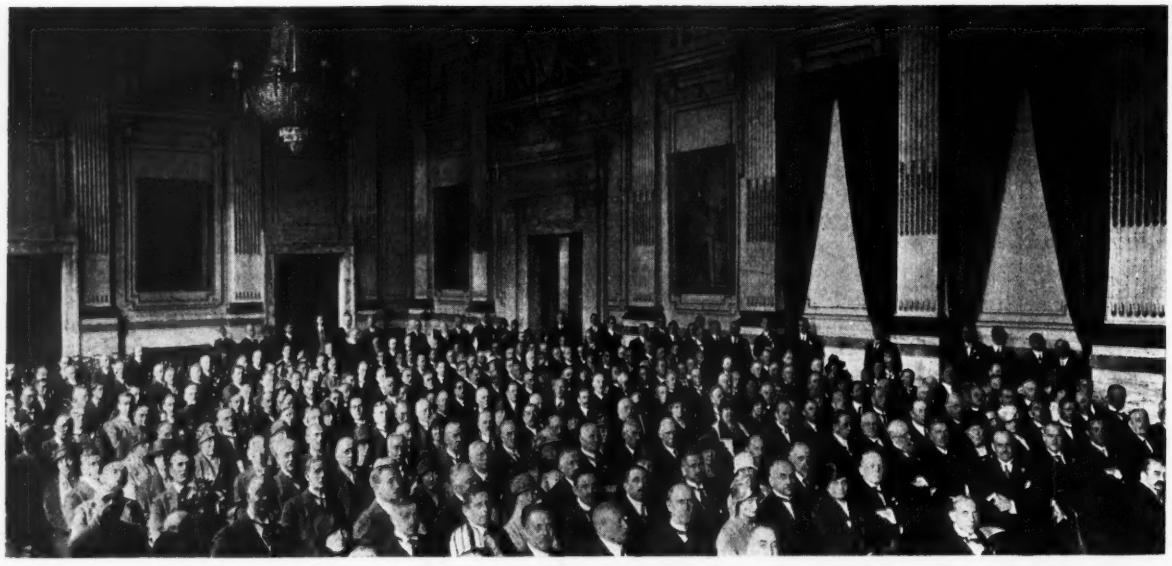
While an examination as the criterion for the selection of candidates for promotion has no place outside of civil service where it constitutes the lesser of two evils, examinations of railway employees, particularly those of the maintenance of way department, cannot help but prove of some value to the officers of the department in acquainting them with those of the employees who are taking active interest in their work and in identifying those who evidence a superior mentality, which if rounded out with other requisites for success, will prove likely candidates for promotion. In view of these considerations, it is believed that the article on the voluntary examinations on the Nashville, Chattanooga & St. Louis which appears on another page will contain many valuable suggestions for those who are studying the problems of personnel.

IS NEATNESS A FAD?

IS NEATNESS a fad or is it a meritorious measure which deserves the consideration of supervising officers? On few subjects are there greater differences of opinion, at least as evidenced by actual practices. On the one hand, there are those who oppose the placing of any emphasis on measures which are designed to stimulate care in appearances and who maintain that there is no return on expenditures for this purpose. On the other hand, there are those who go to considerable length to introduce and enforce measures which have for their primary purpose the cultivation of neatness in the belief that such measures are reflected in greater accuracy and pride in work among employees and that this influence extends far beyond those employees who are immediately affected. Typical of the latter school of thought was Julius Kruttschnidt, late chairman of the board of directors of the Southern Pacific, who stressed measures of this character for years, among which was the maintenance of an accurate toe line for ballast, going to the extent in many places of building this line out of brick bats and stone at a cost of several hundred dollars per mile. As a result, the tracks of this railway present a finished appearance attained by few roads. Entirely aside from the attractiveness of this construction and its possibly favorable influence on passenger traffic, Mr. Kruttschmitt contended that the added cost was repaid many times over by the increased care and pride which employees instinctively took in their work.

Of late another advocate of the same policy has entered the railway field. Following his purchase of the D. T. & I., Henry Ford has extended many of the policies which have prevailed in his factories on to the railroad. One of these is what amounts to almost a mania for neatness. Acting on the belief that an untidy workman is a careless man and that a careless man is extravagant in the use of materials and of his labor, he maintains that it is economy to insist on neatness and to eliminate from his employ those who are not so inclined. As a result a marked transformation has been effected in this property. Here no benefit is secured from the effect on passengers for passenger traffic is negligible and the entire benefit is that secured within the organization.

It is, of course, possible for campaigns of this character to be carried to the point of absurdity. This is a real danger with relatively few roads, however, and most roads and most officers can well afford to give more consideration to this subject.



Opening Session of the International Railway Congress on June 22

How the World's Railways Maintain Their Tracks

Types of Construction and Methods of Work Differ in Many Respects From Those Employed in America

AMONG THE topics discussed at the International Railway Congress which was held in London on June 22 to July 2 were two of special interest to railway engineering and maintenance officers: (1) the maintenance of track and (2) rail failures. Each of these subjects was brought before the congress by papers prepared by "reporters" from (a) America, (b) Great Britain, (c) France and (d) other countries. These papers presented a vast amount of information regarding the practices followed in these various countries. For this reason those treating of the first topic are abstracted below.

Approximately 900 delegates from 29 countries, were present at this meeting representing governments, railway associations and individual railways and including 38 representatives from the United States. Among those from America who were recognized officially were G. A. Harwood, vice-president of the New York Central, who was made a vice-president of Section 1—Ways and Works. The "reporter" for America on the first subject was G. J. Ray, chief engineer of the Delaware, Lackawanna & Western, and on the second subject W. C. Cushing, engineer of standards, Pennsylvania System.

A Review of American Maintenance Practices

By G. J. Ray

Chief Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

WHEN LAYING new rail the general practice of American railroads is to renew all rail fixtures excepting tie plates. When heavier rail with a wider base is used it is, of course, necessary to change the tie plates. The constant increase in the weight of rolling stock, together with the increased traffic, has made it necessary to greatly increase the weight of the rail. In some cases, where the increase in weight of the rail has been small, or the height of the "T" section can be safely increased without widening the base, the latter is kept constant so as to avoid the expense of renewing tie plates throughout. As a rule, however, the heavier rails require a greater width of base and the renewal of tie plates, bars, bolts, nutlocks, etc. The usable rail and fixtures released are utilized elsewhere in tracks of less importance.

A number of railroads follow the practice of laying new rail in the winter, thereby reserving the summer season for general maintenance work. However, a majority of them lay new rail in the spring and summer and as soon as possible thereafter space and renew ties and surface the track. Some roads using very heavy rail, 130-lb. per year and upward, and thus securing unusual girder strength, have found it possible to eliminate the shifting of joint ties and the spacing of ties at the time the rail is laid. Most of the roads using such heavy rail claim that a material saving in general track maintenance is accomplished. A few lines use the dependent flange or bridge joints which require that joint ties be shifted as the rails are laid, or the rail first laid with plain bars, and the dependent joints substituted when the ties are shifted.

The spacing of ties under new rail is usually done when the track is given a general surfacing. Only a slight lift is made in order to disturb the old bed as little as possible, make the necessary renewals, space the ties and secure a good detail surface.

General Overhauling at Stated Intervals

On some important lines the general repair work is so arranged as to require a general overhauling of one-third or one-quarter of each section every year. Under such a schedule all of the track is overhauled every three or four years, which allows the work of raising, respacing, tieing, surfacing and ballasting to be performed in the order mentioned. Such track will usually go through three or four seasons without much attention except the necessary raising of low spots, relining and an occasional tie renewal. This method of maintaining track where the necessary labor is available locally to the section, produces the most uniform and satisfactory results. Where extra gangs must be used to do all general repair work, large gangs are usually employed and long stretches of track are overhauled out of face.

Where through lack of funds, or when the necessary labor is not available the track must be maintained with an insufficient force, the necessary tie renewals are made each year on the entire section by digging in the ties. This practice is also usually followed for some years after track has been given a lift of 6 to 12 in. on new ballast. Where a considerable depth of new ballast is placed it is considered good practice to remove all ties that are not good for at least three years to avoid disturbing the bed for some time after reballasting.

The general practice of reballasting track where new ballast is to be applied is to make the first raise on old ballast unless it is very dirty, in which case it is shoveled out for widening and strengthening banks, or screened and the first raise made on the cleaned stone, while the dirt is used to repair banks. In order to have proper drainage for tracks it is necessary to clean the ballast at intervals of three to seven years, depending upon the kind and amount of traffic, subgrade conditions, etc.

Rail Renewals

New rail is usually laid by regular section gangs and extra gangs, or a number of regular section gangs from that part of the division on which the rail is to be laid. The renewal and spacing of ties is usually handled by the regular section gangs where the amount of work will not require too much time, otherwise extra gangs are employed for the purpose. In locations where the necessary men are available, it is more satisfactory to increase the section gangs by the employment of local men for the laying of new rails, renewing and spacing of ties, and it is believed that the work is thus done with greater economy than is possible with extra gangs.

Careful inspection of ties to be removed is very important, especially at present on account of the high cost of labor and materials. Treated ties are now quite generally used on the more important roads. There is an opportunity for much economy in securing the maximum life of these treated ties. Much attention is now being given to the question of the best tie plate and rail fastening to secure the maximum life of the tie.

Motor Cars

The use of motor cars where traffic conditions will permit has enabled a number of railroads in the United States and Canada to lengthen the sections maintained by foremen with a given number of men, or reduce the number of laborers previously required to maintain them. In the United States during and after the war, when the federal government had control of the railroads, an eight-hour working day was established for maintenance labor, whereas formerly, the established working day for maintenance men during the working season was ten hours. Of course, more men were required to do the work in an eight-hour day. The advent of an efficient motor car has materially assisted in keeping down the necessary additional force. This is due to the fact that the men are transported to and from work quickly and are not worn out from pumping hand cars.

The motor car has been found economical for the handling of small material such as bolts and spikes; and by using trailers, ties have been handled short distances. The mowing of the right-of-way in favorable locations is also accomplished by placing a mowing attachment on a motor car, thus effecting a considerable saving. The most satisfactory types of motor cars are those having a free running engine. The original type of motor car that had to be pushed along the track to start the engine was unsatisfactory and dangerous.

There are many dangers connected with the operation of section motor cars and great care is necessary in enforcing rules as to their operation. Cars can only be operated safely on heavy traffic lines under the

Some of the American Delegates and Members of Their Families

most careful flagging. They should never cross highway grade crossings except under control and two cars should never be operated close together; otherwise, if the head car should be derailed the rear car is apt to collide with the derailed car.

Tamping Machines

With the inefficiency and shortage of labor, the economical generation of power by the use of portable gasoline engines, connected through a common shaft to a dynamo or air compressor, has opened the field for tamping ties mechanically. Section gangs on some of the heavy traffic lines are fully equipped with pneumatic tamping machines. The first pneumatic tamping machines placed in general use were only large enough to operate two tamping guns. These machines have proven satisfactory for small gangs but insufficient for large gangs. The machines which seem most likely to be used in the future are larger compressors operating 4, 8 or 12 tamping guns. With these machines one, two or three ties can be tamped on each end and both sides at the same time.

In connection with the tamping machine, tools have been developed so that much of the track work besides tamping ties can now be done with a very great saving in labor. Rails are drilled for switch and signal work; holes are bored in timber and in ties for cut or screw spikes; screw spikes are driven; nuts are run up on bolts at rail joints, where new rail is being laid; rivets are cut out or driven on steel work, etc. At terminal plants where air is available the tamping guns and other appliances operated by compressed air are used to advantage without the portable power plant. Since tamping machines are generally located at or near all outlying stations they are always available for quick use in the case of emergency such as power failure at an interlocking plant operated with air.

It is claimed that track tamped with pneumatic tie tampers is more uniform, and that it will hold its surface and line longer than when hand tamped. In addition to this saving, much man power is conserved for other work. At least one hundred per cent more ties per man can be tamped with the machines than by hand. Ties are tamped more uniformly and each man must perform an equal part of the work.

The introduction of gasoline-operated machines requires special mechanics for the maintenance of the machines. On railroads where large installations have been made it has been found necessary and economical to employ a special organization for the purpose of repairing the machines and instructing track foremen in their use and care. Satisfactory results have been secured where one man, a mechanical foreman or supervisor, is given charge of all motor cars and tamping machines on a division or possibly on two or three divisions, depending on the length of the divisions and the number of the machines. It is his duty to have repair men make light repairs on the road during the summer season and give all machines a general overhauling during the winter.

Laying Rail by Machinery

The distribution of new rails and the loading of released rails are usually handled by air or steam operated derricks in work trains. A number of the railroads report economical results gained by using the three-man rail layer when laying rail on the main tracks. This machine consists of a small frame mounted on four wheels and having a windlass to which is attached a chain carrying an idler pulley with rail tongs. The machine employs from five to seven men.

Locomotive cranes are extensively used by some railroads when laying rail on long stretches of main track. It is claimed that one locomotive crane will keep 200 men busy pulling spikes, throwing out old rail, spiking, bolting and bonding the new rail set in place by the crane. Three men and an engineer are needed to place the rails in track. On double or multiple-track systems where traffic can be diverted from the track on which the rail is being laid material economy can, no doubt, be gained by the use of locomotive cranes, especially with the heavier sections of rail.

Several track liners have been placed on the market during the past two or three years. Their use is particularly adapted to small maintenance gangs. With these liners the heaviest track can be lined in stone ballast with three or four men and switches can be lined with seven or eight men. Track that needs to be moved only small distances can be lined without digging the ballast from the ends of the ties.

Ballast Cleaning

The inefficiency and high cost of labor has made ballast cleaning by hand with the ballast fork a very expensive maintenance item. As a matter of fact, it does not pay to clean ballast on a roadbed where the tracks can be raised on new ballast. Unfortunately, the fixed grades at stations, bridges and overhead obstructions on portions of all railroads prevent the necessary raising of tracks to avoid digging out and screening ballast.

The cleaning of ballast by machinery has been given a great deal of study by maintenance officers of railroads who have to do with stone ballasted track. In an effort to reduce the cost of performing this work, a number of the railroads are using locomotive cranes equipped with clam shell buckets. The ballast is first dug out from between the ties by hand. The dirty ballast is then picked up from the inter-track space and shoulders. It is dumped on an inclined screen mounted on a gondola or dump car from whence the clean ballast is returned to the roadbed, leaving all of the fine stone and dirt in the car which is later unloaded on banks where needed.

Several railroads are using a rotary ballast cleaner. This machine consists of a gasoline engine driving a cylindrical screen and three conveying belts mounted on a skeleton standard gage truck or push car. The machine can be moved on or off the track in five or six minutes, or, if more convenient, can be run to a siding under its own power.

In operating this machine the ballast is dug out from between the ties to the inter-track space or shoulders. It is then shoveled on to a conveying belt which delivers it to a revolving screen from which the thoroughly cleaned ballast returns to the track. The dirt is conveyed on a belt to the embankment. This machine will handle as much dirty ballast as 14 men can shovel on to its conveyor.

Other Work Equipment

Ballast is distributed on the track with special ballast cars. Other hopper cars such as coal or ore cars are also used for hauling and distributing ballast, especially where the ballast haul is in the same direction as the movement of the light cars. Standard gage air dump cars are now being used very extensively on American railroads for handling refuse, cinders and excavated materials from cuts and ditches. Cars that dump so as to clear the track, including the ballast shoulder, are preferable for this kind of work.

Spreaders are used for plowing ballast off the track, cutting ditches, spreading waste materials and forming banks. Such work is done at a very low cost as compared with hand work. Ditching machines used in conjunction with air dump cars can handle ditching work for less than one-half of what it costs by hand. These machines really consist of a small long-boom revolving shovel mounted on a flat car. It is operated in either direction, and dumps the excavated material into a dump car located on either end.

As a rule, on well ballasted main line tracks in America, mechanical or chemical devices for killing weeds are not economical and such vegetation as grows is removed by hand or destroyed in the regular working of the ballast. The operation of a weed destroying machine is economical on stretches of track covered with a heavy growth of vegetation, and the methods most commonly used for the destruction of such vegetation are the application of super-heated steam or the spraying of a chemical weed killer.

The Practices of France and Her Colonies

By R. Ruffieux

Chief Engineer, Central Permanent Way Department, Paris, Lyons and Mediterranean Railway, Paris, France

THE MAINTENANCE of the permanent way is accomplished by local workmen known as "cantonniers," who are formed into gangs. These gangs are grouped in districts, the districts into sections, and the sections into "arrondissments" or divisions, which are placed directly under the control of the chief engineer of the line. On most of the lines, the average number of men forming a gang has not changed much in spite of the recent application of the eight-hour law, but the number of casual day laborers has increased.

On heavy traffic lines the general tendency when forming a gang was to make use of the coefficient of 1.6 men per mile for double-track railways, a coefficient which would naturally be reduced according to the importance of the line. On main lines the length of a section varies from 2.4 to 3.7 miles, and on secondary lines from 4.3 to 6.2 miles.

The average effective man power on important lines (with the exception of Alsace-Lorraine, where the force is at present excessive) varies from 0.64 to 0.96 men per mile on single-track lines, from 1.34 to 2.12 men per mile on double-track lines, and from 1.6 to 4.09 men per mile on lines with four tracks. Of late there has been a tendency to group the gangs at large stations and place them under the control of a line inspector, a higher position than that of gang foreman; on secondary lines to group several gangs into one with a reduction in the force, and make use of motor cars for the transport of men and material, and finally, to create "flying squads" on certain lines which can be sent to different points as necessity arises, in order to assist the local workmen (Algerian State railway), or even, on small lines, to do the work entirely by this means, allowing permanent gangs to be dispensed with (Nord railway of France).

Daily systematic rounds of inspection are general. The time allowed for these rounds amounts to 20 min. per kilometer (0.62 mile). On the large railway systems this absorbs each day more than 12,000 hours, or 1,500 man days, which some think might be more usefully employed.

Thorough Overhauling is the Rule

On the large railway systems of France, as well as on the Algerian and Tunis railways, the method of carrying out maintenance work most generally adopted is that of a general relaying or periodic general overhauling of the track. It includes all possible operations relating to maintenance work, and is applied periodically to all the sections from one end of the main line to the other, taking a portion of each section each year. At each point all of the elementary work of general relaying, the necessity for which is apparent, is attended to, and the track is put into as perfect condition as possible. Between two consecutive periods of general relaying on a particular portion of the line a certain time elapses, which, according to the present system on the French railways, varies from one to eight years. During this interval the upkeep is assured by means of a methodical annual overhauling which is less drastic in its nature, and only partial or isolated repairs are made at places where it is found absolutely necessary to do so.

The colonial lines and the French administrations in foreign countries generally keep their lines in repair by "ordinary inspection" or isolated repairs. The Damas-Hamah railway, however, keeps its old lines in order by methodical repairing, and is satisfied with the results obtained.

Standards of Construction

On main lines, rails generally last from 25 to 50 years, while the life of ties of treated hard wood is variable, depending on the traffic and the method of treatment of the wood. It averages from 25 to 30 years on these lines, on which there are, however, at the present time some ties which have given 45 years service. Pine ties that have been well creosoted last from 10 to 20 years and metal ties from 40 to 50 years.

Except at those places where there is frequent brake action, such as points for stopping or reducing speed, rails generally become unserviceable through wear at their ends, and where they are supported by fish plates, before having reached the limit of wear allowed on the rail head. The best method, therefore, to lengthen the life of the rails and fish plates is to improve the joints and the stability of the joint ties, a point all the companies have under consideration.

Some railways reclaim their old fish plates by restamping them hot, so as to give them an improved section and a close fit when replaced in position. By this method their life may be considerably increased on the main lines.

Increased importance is attached to the prevention of creeping of the rails. A trial was recently made on the Paris-Lyons-Mediterranean of a substitute for the usual anti-creeping devices, by welding the rails to metallic plates with flanges screwed down to the four or five central ties under each pair of rails. New rails will henceforth be placed directly on the wooden ties, except on those which are provided with anti-creeping or welded-up plates.

Finally, the increase in the price of wood, and its

scarcity, have led certain railways, which hitherto had abstained from the practice, to use metal ties on lines having an average or light traffic, and also to increase the experiments with ties of reinforced concrete. Once placed, these two kinds of ties are considered to require less labor to keep in good repair than those of wood.

Methods of Work

The practice of "shovel-packing" is increasing continually and is now employed on most of the important lines. It is, however, only efficient on roadbeds which have acquired a certain compactness, and where the raising of the rails is only of small account. Pick and bar tamping cannot, therefore, be entirely dispensed with, and is still used for reballasting and in cases where the raise is a heavy one.

Mechanical tamping is not in general use, although on the P. L. M. trials are being made with the view of allowing certain gangs to use electric tampers, which can be worked at all the necessary angles in order to obtain a homogeneous tamping effect throughout the whole depth of ballast. This tool is especially useful on sections of the line where frequent tamping is necessary, and has to be methodically repeated, either for the rapid consolidation of new ballast or for periodically raising joints which are always sinking on bad road beds. Two or three men are sufficient to do the work, which need not interfere with the ordinary upkeep of the line.

Since 1922 some lines have used a weeding machine which had already been in operation on the Swiss Federal Railways. This method is less costly than ordinary weeding by hand, and requires less labor. On the other hand, trials were made in the autumn of 1923 by the P. L. M., to destroy plants growing on the lines, by spraying them with a concentrated liquid weed killer from a portable apparatus. The latter, which only weighs 33 lb. when fully charged, is similar to those used in vineyards to sulphate the vines. Plants so treated withered away very rapidly and had not reappeared in the spring of 1924.

The present tendency is to clean the ballast at the time of the general relaying in cases where its nature allows this to be done, except when clayey material has risen from the road bed through the ballast. Periodical screening of the top layer, done before the impurities have reached the underside of the ties, is sufficient to maintain the ballast in good condition, and obviates resort to heavy screening or repairs. This method is economical, and at the same time avoids recourse to slow orders. The experience gained with this method on the Nord Railway—which has used it for some time—is particularly striking.

Both Company and Contract Forces Employed

In principle, the upkeep of the line is carried out entirely by the permanent force, but on most of the railways, with the exception of Alsace-Lorraine, it is necessary to engage temporary labor in addition, especially on important lines. The average upkeep, properly so called, carried out by methodical relaying and partial or isolated repairs, annually absorbs 240 to 420 man days per mile of single main line. The annual number of working days per individual being 313, the corresponding theoretic individual value varies from 0.76 to 1.33 men per mile of single main lines. This nearly corresponds to the average requirements already mentioned, 0.64 to 0.96 men per mile of single and 1.34 to 2.12 men per mile of double track.

In reality, the gangs have not only to deal with the real upkeep of the line, but also with the various accessory jobs not included in the methodical relaying, or in the partial or isolated repairs. The mean annual number of eight-hour man days charged to this class of work varies, according to the particular railway, from 80 to 260 per mile of single main line, or 20 to 38 per cent of the time that is charged to the gangs for the work for which they are responsible.

The proportion of the yearly number of days worked by casual labor to that of the permanent force varies, according to the particular railway, from 3 to 90 per cent on the large French systems, 50 per cent on the Algerian and Tunisian lines, and 75 per cent on the others. In certain parts of France, however, where auxiliary labor cannot be obtained, the work is given to contractors.

The calling in of contractors is forced on the companies by circumstances, and the work entrusted to them includes either the methodical relaying at so much per lineal yard of track, under well-defined technical conditions, or only that part of the relaying work which does not require special knowledge of the line, but is more a question of time and labor, such as replacing ties, screening ballast, etc. The first method is rarely employed, because it is considered preferable to allow the permanent gangs to deal with the delicate operations of upkeep. Contracting, however capable, is not advisable for the upkeep of tracks and switches at important stations, where it is also difficult to fix prices on account of the interference caused by the running and holding up of trains and by switching operations.

Generally speaking, the work entrusted to private enterprise is let by tender to the firms who specialize in this class of work. From the economic point of view, the work done by the contractor's which is generally paid piece work, is often superior to that of the company's own men, who, being employed by the month, have no incentive to get the job done in a certain time, and prefer, contrary to the contractor's men, to do the job well rather than quickly. So long, therefore, as the company's men have a fixed rate of pay, it is not possible to give piece work prices to casual men working with them. That is to say, it would be impossible to pay a certain number of men in a gang fixed wages, and the remainder on piece work prices, for the same class of work. In any case, however, it is generally agreed that the contractor's charges, coupled with the cost of supervision, render the expense of maintenance heavier with the system of contracting than with that of the permanent force.

Work Is Done Under Traffic

Renewals of the track consist in either changing the ties at the same time as the rails, etc., or in repairing them. The first process generally takes place when a change is made in the type of rail, especially when old tracks are relaid to allow heavier engines to run over them. When renewing in case of wear, and the new rail is of the same type as the old one, some railways have a tendency to keep the old ties in service for economical reasons. The French Nord takes advantage of renewals of the rail to clean the ballast, and replace with new material the waste caused by screening.

Renewal of the rail or ballast is done almost exclusively by contract, except in the case of the French state Railway, which prefers making use of its own resources in instances other than when large quantities of ballast are required, and on certain secondary lines. The contractors are generally required to make good any defects that may be noticed within two

months after they have finished their work. The requisite material is generally assembled by the contractor's force, and carried from the place of storage to its destination by work trains. It is of course understood that the railway officers are responsible for all measures relating to the safety and running of trains (slow orders, flaging, etc.) and supervision.

It is extremely rare on double-track railways that a track is taken entirely out of service while under repairs, and the remaining track operated as single track. One railway resorts to this method only in very exceptional cases. In general practice, the slowing down of the trains is found to be sufficient, and sometimes in the case of relaying, when one rail after another of the same type has to be changed (as pointed out by the Midi), slow orders are found unnecessary.

As delaying of the traffic necessarily causes much inconvenience it should be reduced to the minimum, which, in the case of relaying, necessitates a large force. This is the chief reason why most of the railways do not have this work done by their own men. Contractors can supply from 100 to 200 men, which is too large a number for the railways to concentrate at one point, and it would also force them to weaken numerous gangs which are required for maintenance work in other places.

Cost of Maintenance Work

According to the statement issued by the Permanent Way departments of four of the great French railways for 1922, the men forming the repairing gangs (permanent and temporary), cost on an aver age for upkeep and supervision, exclusive of those men occupied in renewal work, about 40 per cent of the total cost attributed to maintenance work less general expenses. The material and ballast used in repairs only represented 12 per cent. On the Algerian and Tunis railways these proportions work out respectively at 56 per cent and 20 per cent. From this it is certain that making proper use of the working force is one of the most fruitful sources of economy.

British Practices Include Many Interesting Features

By W. H. Coomber

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THE PRINCIPAL event of recent years in the history of permanent way engineering in Great Britain has been the standardization of track by a Committee on Standardization of Railway Equipment-Permanent Way, Track and Signaling. Track constructed in accordance with the standard drawings approved by the committee is now in actual use upon many lines. Plans for the switches and crossings are undergoing final consideration. The importance of efficiency and economy in maintenance has been kept prominently in view in designing the component parts of the track.

Track Construction Standardized

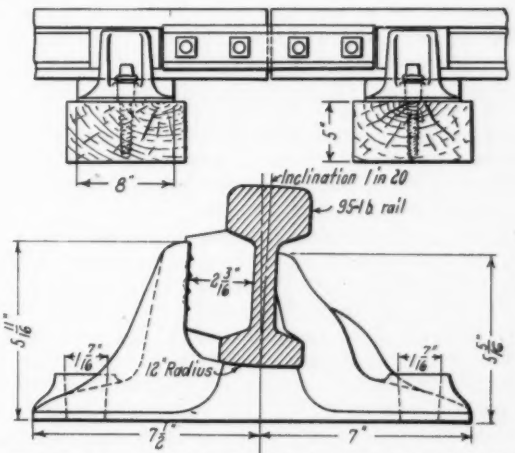
The rails are of the British Engineering Standards Association sections, the proposed standard lengths being 45 ft. and 60 ft. The fish plates are to the design of the same authority. The tie is 8 ft. 6 in. in length, being 6 in. shorter than that previously in common use. Two patterns of ordinary chairs (a device which has no counterpart in American construction but which is employed to support the English bull-head rail on the tie and to hold it in position—Editor.) are provided, one whose normal use is for 85-lb. rails and the other for 95-lb. rails. The chairs will take, within certain limits, other British Standard section rails. The chair is provided with holes for three steel screw spikes. The chair keys are of hardwood, tapered 1/16 in., and it is intended that there shall be only one pattern of key which will suit every purpose. The adoption of the standard designs is, of course, optional, and certain alternatives will be included, especially as regards the switches and crossings.

Most British railways will, no doubt, use the British Standard section rail weighing 95 lb. per yard for their primary lines and that weighing 85 lb. for their secondary lines, though on the Southern railway and the Great Western railway the 95-lb. section only is being used at present. The London, Midland & Scottish railway has adopted a standard rail length of 60 ft.; the remaining British railways are using a standard length of 45 ft.

Ties on most of the British railways are of creosoted red Baltic lumber, although occasionally Oregon pine is used, and on some of the Scottish lines the native pine is used partially or wholly. Special ties and chairs of increased size adjacent to the rail joints are included in the standards for the heavier section of rail, and these are, as a general rule, used on the primary lines only.

Some companies galvanize the screw spikes with the object of prolonging their life; other companies have not adopted this practice.

The ballast is of considerable variety, both in the nature and size used; the dimensions of the road bed also exhibit variations. Granite is looked upon as the best material, but can only be obtained at an economic cost on a few lines. Blast furnace and steel slags are much used where supplies are readily available. Cinder ballast is now being superseded by stone or slag where a sufficient supply can be obtained at an economical cost; where the railway is subjected to subsidence cinder ballast is used, otherwise successive liftings of the tracks would cause large quantities of the ballast to disappear gradually below the ordinary level of the ballast. The



Fish Plate and Chair for English Bull-Head Rail

use of slag ballast is generally avoided in tunnels because in damp and confined situations it is considered to increase corrosion of the track. It is not used on the electrified lines of at least one road, on account of certain chemical properties, and also because it is considered too retentive of moisture.

The Woods Used for Ties

Ties on colonial railways are usually of native timber, although sometimes they are imported, Australian jarrah being commonly used on the South African railways. This timber is used untreated as in Australia, while the ties of native wood are cresoted. Preservation of ties is not usual as in Great Britain. Indian practice shows the greatest variations in the type of ties in use, both as regards design and nature of materials. Native and imported woods, cast iron and steel are all in fairly extensive use. One railway has adopted the steel tie as its standard for a great portion of its lines; another has laid a considerable quantity of reinforced concrete ties. These are in the experimental stage and it is stated that if it appears probable that they will last 30 years, they will seriously rival ties of wood.

Practically all British railways use a guard rail on curves of 660 ft. radius or less. The generally recognized purpose of the guard rail is to safeguard rolling stock against derailment. The provision of a guard rail on curves of 660 ft. radius or less is compulsory under the regulations issued formerly by the Board of Trade, and now administered by the Ministry of Transport.

The Great Central section of the London & North Eastern railway extends the use of a guard rail to all curves under 1,320 ft. radius and further, staggers the joints of the two running rails where the curve is of 1,980 ft. radius or less.

The guard rail strengthens the track, and is more effective in this respect when the gap between it and the running rail is such that the wheel flanges press against the guard rail, causing it to assist in taking the outward thrust on the track and also to share the side wear or cutting which otherwise is wholly taken by the outer rail of the curve. The guard rail flangeway has in the past varied on different railways from 1⅞ in. to 2½ in.; with the wider of these openings the wheel flanges seldom press against the guard rail. The standard design of guard rail chair now used allows a gap of 2 in. only and this no doubt will cause the guard rail to take a share of the side pressure.

On the South African railways guard rails are provided not only where necessary as a safeguard against derailment, but also on curves for the specific purpose of increasing the life of the outer rails; to aid in this object they are kept well lubricated. These measures are said to prolong greatly the life of the outer rail and to effect a still greater saving in the wear of tires of locomotives and cars. On the other hand the New Zealand railways report that guard rails have been used on sharp curves to reduce wear but have not been found economical.

Increasing the Number of Ties

Probably the simplest way of increasing the strength of the track as a whole is to add to the number of ties. This method is adopted by several railway companies for sharp curves, at track pans and in tunnels. In tunnels it is common to lay the heaviest section of rail ordinarily available but a specially heavy section is occasionally used, as for instance, 100 lb. per yard on the New Zealand railway.

No special methods are reported for the prevention of rail creeping on the British railways, except on the Great Eastern section of the London & North Eastern railway, where linking the ends of certain groups of ties by iron bars has been tried but appears not to have proved successful. The present tendency seems to be to rely upon a carefully designed chair jaw and hardwood key. It has been found that a teak key of good length (6 in.) with its side, top and bottom fitting tightly to the rail and held by a serrated chair jaw is effective in reducing creeping. In climates with greater ranges of temperature, however, rail anchors appear to be a necessity and various types are in common use in India, Canada and elsewhere.

Only one British railway mentions the use of special steel for rails on sharp curves under dense traffic. On the South African railways it has been found that manganese steel rails are not a success on steep gradients on single track lines, being too smooth for adhesion on maximum gradients, causing severe slipping of engines. In other situations they have proved very satisfactory. Sandberg's silicon steel has also been used for the rails on curves on these railways with an increase in life of 60 to 100 per cent on the outer rails, but only 25 per cent on the inner rail.

Care Is Given to Materials

The chief effort in the direction of lengthening the life of the component parts of the track is the annual lubrication of the fished rail joints, which, introduced some years ago, appear to have lately become more generally adopted. The lubricants or preservatives—they serve as both—are tar or recovered machine oil. One railway is experimenting with the grease recovered from the gear boxes of electric rolling stock; having more "body", it is anticipated that the grease will not dry up as quickly as the "thinner" substances. One of the Indian railways states that the fishplates are "graphited" and the nuts and bolts oiled once a year. Several replies state that the rails laid in tunnels are painted with red lead, and others that they are coated with tar. It may be assumed that the painting or coating is done only when the rails are first laid.

When the bearing surface on the rails has become so worn as to cause ordinary fishplates to have little or no grip, the North Eastern section of the London & North Eastern railway finds that the use of "maintenance" fishplates which are slightly greater in depth than the normal fishplates has materially reduced the wear and tear on the ties and fastenings at and close to the joint. One Irish railway reports that on secondary branch lines worn fishplates are milled and re-used with channel section liners. On the same railway high speed saws and drills have been installed for dealing with rails whose joints and ends are defective and the results have proved satisfactory. On the South African railway the worn ends of rails are cut off, re-drilled and fitted with new fishplates, to defer complete renewals.

On the Great Northern section of the London & North Eastern railway curve worn rails on all main tracks are turned. This has been observed to be the practice on several railways, and is being contemplated on other lines which have previously discarded for main tracks, rails where the head is much worn on one side.

On the District railway (London) the rails are particularly subject to uneven wear or "battering." Rails worn in this way are taken up, machined to give an even surface on the top and replaced in the track; this gives an increased life of about 100 per cent while the approximate cost of machining is only $2.50 per ton.

As a means of prolonging the efficient life of stone ballast, mention may be made of the practice of regularly screening the ballast, which is lifted from the track,

freed from accumulated dirt, sand or engine cinders, and replaced. This procedure is carried out on several British railways regularly by the section gangs and also where, in relaying, the old ballest is used again.

The Maintenance Organization Is Largely Permanent

There has been little or no recent deviation from the almost universal practice of making routine repairs and renewals which is as follows:

(a) The minor daily upkeep repairs are carried out by small section gangs each maintaining a small section of railway;

(b) More important repairs beyond the capacity of the section gangs are occasionally done by special gangs, but in most cases they are carried out by relaying gangs, no other special gangs being employed;

(c) Partial or complete renewals of the track, i. e., relaying rail and renewing ties are undertaken by special gangs.

Both in Great Britain and the Dominions all work on the track is now carried out by the company forces except certain special work in a few instances on the Indian railways.

It is not usual to increase the section maintenance gangs seasonally. The only strengthening of these gangs recorded is by the drafting of men from the special gangs to assist in raising the track in cases of subsidence, etc., except on the African railways where it is necessary to increase the gangs during the wet season.

On English railways the relaying and special gangs consist of men regularly and permanently employed. A few railways, however, employ gangs of temporary men each year and dispense with them when the work for which they are engaged is completed. In other instances a permanent gang is employed as a nucleus, reinforced as required by casual labor or by regular men drawn from the sections.

The system of organizing relaying gangs from "gathered" sectionmen, either as a unit or to reinforce a small permanent gang, predominates in Scotland. On the Dominion railways regular permanent gangs are not usually employed for the complete renewal of the track, temporary labor being recruited for the purpose.

Working Conditions

Many of the conditions of service on the British railways are now stabilized by agreement between the companies and their employees. The latter are represented upon councils and committees established in conformity with the Railways Act of 1921. Some of the agreed conditions have a considerable effect upon the economies of track maintenance, as for example, that fixing the normal working hours at 48 per week. There are some variations in the actual apportionment of the 48 hours; a common arrangement being 8 2/3 hours on Monday to Friday inclusive and 4 2/3 hours on Saturday. The only railways on which the normal working hours exceed 48 per week are several in India and the South African railways. On the latter the hours worked in summer exceed those worked in winter.

The daily period of duty for which payment is made for section gangs is regarded as commencing and terminating at the nearest track layers cabin to the work in hand for the day; that is, where they leave their tools at the close of the day's work, but this rule is not universal. The special and relaying gangs are generally attached to a depot and this is the place at which they commence and finish their day's work.

On the railways of Great Britain the housing of workmen calls for special arrangements in a minor measure only for the lines usually run through fairly well populated areas. Cottages have been built for track layers and others engaged in maintenance work, and some of the companies are actively engaged upon the problem of housing as many as possible of the staff near to their work.

In India living accomodation for the maintenance gangs is often provided by "gang lines" which are small buildings divided into six or eight rooms and situated near the center of the section. Many of the men, however, prefer to live in their own villages.

On the Highland section of the London, Midland & Scottish Railway and on several of the Irish railways, where relaying is in operation at a distance from populated areas "sleeping" cars are temporarily located near the work. In South Africa the special gangs are housed in tents or portable buildings. Houses and huts are extensively provided on the New Zealand railways.

Special self-propelled vehicles either for moving sectionmen or special gangs about the sections or for systematic examination of the track by inspectors are very rarely used on British railways. Hand or motor cars are, however, used for this purpose on the African, Australian, New Zealand and Canadian railways, where the distances to be covered are much greater and trains less frequent.

Duties of Foremen

The section foreman is responsible for maintaining the main track and sidings allotted to his care in condition for the safe and smooth passage of trains. In detail this means that the work of the gangs is:

Maintaining the track to an even surface with correct superelevation by surfacing.
Maintaining the track to correct alinement.
Rectifying faults in gage.
Keeping keys, bolts and all fastenings tight and effective.
Adjusting rail expansion spaces.
Renewing odd ties, rail fastenings and fishplates.
Repairing and minor renewals of crossings and switches and their fittings.
Cleaning ballast by screening, etc.
Cleaning drains and ditches.
Weeding the roadbed and keeping it clear of debris. Cutting grass slopes.
Repairing fences to prevent trespass.
Attending to accidents.
Providing flagmen for their own and other departments' work.
Fog-signaling duties.

In some cases other duties fall to the sectionmen such as cleaning and oiling of switches, sweeping driveways in freight and coal yards and about station grounds, cleaning water track pans, etc.

In addition, special duties performed by the foreman himself are:

Inspection of his section (each track) once per day (including Sundays on lines where passenger trains are run on that day), except on the Midland section of the London, Midland & Scottish Railway where the daily inspections are made by the foreman and sub-foreman alternately.
Making further examinations where necessary owing to special conditions, such as subsidences, excessive heat, floods, etc.
Keeping the time of the gang, particulars of work done and records of material received, used and recovered.
Reporting to the supervisor any serious defects, accidents, encroachments, etc.

The remarks above are intended to apply particularly to British practice but with some variations they are applicable in general to the colonies. There are, however, some exceptions, for instance in India it is not thought desirable to give native foremen the responsibility for work entailing the removal of a rail from the track nor are they required to do clerical work of even the simplest description. Some variations also exist in the colonies in the arrangements for the examination of the track.

A gang of 20 men appears to be the minimum advisable for relaying gangs and even with that number, assistance by a ballast gang in connection with ballasting and

the handling of old materials is usually necessary to make satisfactory progress.

On British railways relaying operations are usually carried out in the spring and summer months but are not stopped during any particular period of the year on account of weather conditions. Exceptions are that relaying is avoided on main lines during busy holiday traffic. In countries with rainy seasons, as in India, the Malay States and Nigeria, and also where the winter is severe, relaying operations are completed before these seasons begin and the relaying gangs, which are composed of temporary men, are discharged.

On the majority of lines Sunday is used for the actual taking up of the old track and laying the new, the removal of the ballast between the ties and some other preliminary work being done previously on week days.

An Example of English Track

There is a growing tendency to seek means by which more of this work may be done on week days, but it is found almost impossible for this to be done on some of the more congested lines.

Actual figures for the purpose of comparing the cost of week day with Sunday relaying are not available, but the Great Western Railways experience that weekday relaying is less costly than Sunday relaying providing that intervals between the passage of trains are sufficiently long to permit of a considerable length being laid at each break of the track may be taken as being in accordance with general opinion.

Men employed on track repairs or renewals are not paid on piecework or premium methods nor, except in a few cases in India, are contractors employed for such work.

Methods of Training Foremen

There does not appear to be a regular system of training and instructing minor officials as foremen and workmen in the technical performance of their duties. The workmen gain their practical knowledge and experience from the men in charge over them.

The only direct educational measure recorded in the British replies is the delivery of a course of evening lectures on the "Permanent Way" at some of the principal centers on the London, Midland & Scottish Railway during the winter of 1923-1924. This course was an extension of an educational scheme then existing which included regular classes in clerical and similar work; the lectures on permanent way along with others on technical subjects were added. These lectures were purposely of a general nature and all members of the staff of the company were invited to attend.

It must also be remembered that the men on British railways have usually more opportunities of benefitting by intercourse with others dealing with the same or similar problems than workers in less populous countries. As regards such countries it is not unusual to issue pamphlets or books of instructions giving correct methods of working, standard dimensions for the more common track arrangements, particulars of component parts, etc. Such a manual is issued by the chief engineer of the Bengal & North Western Railway and is supplied to all permanent way inspectors, sub-inspectors and minor supervisors. A similar book of instructions is issued on the South African railways.

In the Federated Malay States permanent way supervisors attend a three-months course at the engineering department training station. Future promotion depends on ability to pass an examination at the end of the course. First and second class certificates are issued on the results of the examination. Foremen attend a two weeks course of instruction at the training station.

On the South African and on a number of Indian railways there is a system of apprenticeship. On the South African railways youths are systematically trained for posts of foremen and permanent way inspector (supervisor), and have to pass an examination before being appointed to the position of third class foremen. This system they state to be the only one which has turned out efficient foremen. Native and Indian laborers receive no special training, being as a rule illiterate and therefore not capable of benefitting by lectures or literature. In New South Wales the Railway Institute undertakes the education of the men. A text book on track-laying has been published and correspondence classes are conducted.

Little Labor-Saving Equipment Used

About one-half of the British railways use hopper ballast cars discharging in the center or on both side and center. In most cases a plow attached to the bottom of one of the cars is employed to spread the discharged ballast. Hopper cars are also used in Australia and New Zealand and on several of the Indian lines. Several companies have cars specially built with low floors for handling ties and rails.

On British railways there are very few instances of special vehicles being used for the transportation of men. Velocipede cars or rail cycles are reported as being in use on only one English railway, but they are used more frequently on the Irish and colonial lines, where the inspection motor car is also used to some extent by the engineers and inspectors.

Perhaps the most used mechanical appliance on the track is the lifting jack. A number of different types of the bottle shaped screw, ratchet jacks, and also jacks of the Golightly type are employed. The last named have the advantage of not fouling the track when in use.

A device by which correction to the alinement of heavy crossings may be carried out by an ordinary section gang, has been recently introduced. This consists of a base plate and frame containing a horizontal traversing screw. The frame carries a jack of the Golightly type. The appliance is placed under the rail and a slight lift made by the jack. The traversing screw is then worked to make the necessary adjust-

ment to the line, the screw enabling this to be done accurately.

Mechanical "packing" or tamping has been given a trial on the Great Eastern section of the London & North Eastern Railway but the results have not justified its general adoption. On the North Eastern section of the same railway two mechanical tampers are in use for special work.

The ordinary ratchet drill is largely used for drilling rails but hand-operated machine drills are becoming more common, especially for use by relaying gangs. One company uses an electric drill on its electrified areas and another uses a pneumatic drill on work where many holes are required, a small plant being carried on a car, The practice of cutting rails by the use of the cold set and jim crow is now generally avoided except in emergencies, and one or other of the various types of rail saw is used.

Methods Employed in Countries Other Than Great Britain, America and France

By H. Deyl
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GENERALLY SPEAKING, the methods in use by the different railways, though varied in their nature, may be reduced in principle to two kinds only, namely:

1. Maintenance by "organized inspection";
2. Maintenance by the method of "general relaying".

All other methods are only combinations of these two principal methods.

The Imperial Ministry of Transport at Berlin came to the conclusion in 1923 that the system of general relaying alone allowed the cost of maintenance of the component parts of the track to be reduced to a minimum. It is even rare that much of the smaller material has to be renewed, so that maintenance of the permanent way resolves itself into light repairs and upkeep, which can be attended to by a reduced force.

The advantages of this method are both economical and technical. In the first place it affords the possibility of perfect supervision and control. The work is done with regularity and to a program made out beforehand, and not according to a plan for distributing it over a number of years and varying with the financial condition but to a detailed program arranged for the most

The Works and Ways Section in Session

Instead of employing several small and isolated groups of men, only one gang of larger size works in each district or section under properly organized management, so that not only the control of the operations, but the control of the gangs, is possible. Each year systematic repairs of a fixed portion of the track are effected, so that after a period of from one to several years the whole of the district or section has been overhauled. For this purpose only such work as is absolutely necessary is done in order to maintain track in the required condition in the intervals between general relaying. It is not as a rule necessary, with the evident exception of some odd cases, to replace any ties or rails, or to cleanse or replenish the ballast to any great extent. convenient season or for a time when the work must be done. The result is that this work is more perfectly done, because concentration makes the technical supervision of it more efficient, and the organization of labor cheaper. The amount of work done can be gaged by comparing it with known normal operations from which the good or bad results of the method may be estimated.

It was found that on some of the lines in Czecho-slovakia where this method is being tried, its advantages lay in the fact that insufficiently experienced supervisors were inclined to adopt measures which were too costly for the maintenance of the track, and received the material, particularly the ties prematurely. On the other hand, the disadvantage of premature renewal is

compensated for by the increased life of the component parts of the track on account of the systematic upkeep of the material.

From the economical point of view, it is particularly important to estimate judiciously the degree of perfection in which it is necessary to maintain the structure, the basis of the wheel loadings and the traffic on the line, and to decide the length of the interval between the relayings. In making use of the method of continued relaying, repair work must be limited to small jobs.

As a general rule, the length of the interval between two successive relayings depends on the construction of the track, its condition, its curves and gradients, its age and system of working, as well as the quality of the material used, the quality of the ballast and the nature of the foundation; also the amount of traffic, the speed of trains, and whether the track carries an equal amount of tonnage in both directions and finally the local climatic conditions. If the interval between two relayings is too short, a frequent repetition of repairing increases the cost of maintenance. On the other hand, if this period is allowed to become too long, premature renewal of the material will be necessary.

The regulation of the work during general relaying is greatly influenced by whether or not the ties are "shovel-packed." This method, which under certain conditions takes the place of pick and bar tamping and is used to correct small irregularities in the surface, is as yet only on trial in a restricted sense on a few railways, with the exception of Belgium, where it was introduced over the whole system in 1923. The Czechoslovakian railways, where continued renewal as well as "shovel packing" of ties are now in their first trial, have only made use of this method so far as their main tracks are concerned. The Belgian State Railways, as a result of the satisfactory tests they have made, consider that "shovel-packing" is an advantage, especially as regards economy in labor.

The time necessary to form a solid bed is evidently very variable, depending on the quality of the ballast. The size of the particles of ballast used in "shovel packing" varies from 3/16 to ¾ in. and they must be of a hard material. (Ties placed on cinder or sand beds are "shovel packed".) Judging partly by their own experience, and partly by that of the French railways, the Belgian State railways consider that the cost of doing the work by this method is only half that of ordinary pick and bar tamping.

The number of permanent workmen employed throughout the year varies from 0.8 to 1.92 men per mile, including the foremen of gangs. An ordinary section gang is generally made up of 4 to 7 men and the length of the section varies according to the importance of the line. On main and important branch lines this length is from 1.8 to 6.2 miles, and on minor lines it is longer. The length of a section in charge of a gang must be restricted, so that the supervision and control of the work is not too difficult, and in order to avoid loss of time in coming and going. At large stations, where work is more concentrated, a normal gang may consist of as many as 10 men if the work on the track necessitates more frequent repairs.

The Czechoslovakian state railways calculate their normal requirements of labor on the basis of equivalent mileages, that is to say, miles of single track main lines which are straight and level, with adequate allowances for the relative importance of the line as well as for switches, crossings, etc. The tables from which the equivalent length of track is found (expressed in miles instead of kilometers) are arranged as follows:

1 mile of double track = 1.5 miles of equivalent mileage.
1 mile of single track = 1 mile of equivalent mileage.
1 mile of branch line = 0.5 miles of equivalent mileage.
1 mile of side track = 0.33 miles of equivalent mileage.
1 mile of industry track = 0.25 miles of equivalent mileage.
32 switches = 1 mile of equivalent mileage taking into account of course the complications arising from the sections and gradients by increasing the proportional percentage.

The railways of the German Empire base their figures for the amount of work per man on the average number of hours worked during the whole year. The annual hours required for each district are fixed either by calculation or according to the experience acquired during previous years. These working hours are distributed over the whole year according to the importance of the work carried out each month. For renewing the track a certain number of hours are fixed separately, evidently deducting those apportioned for normal upkeep.

Taking into consideration the intimate relationship between maintenance work and the running of trains,

Ballasting Operations in Denmark

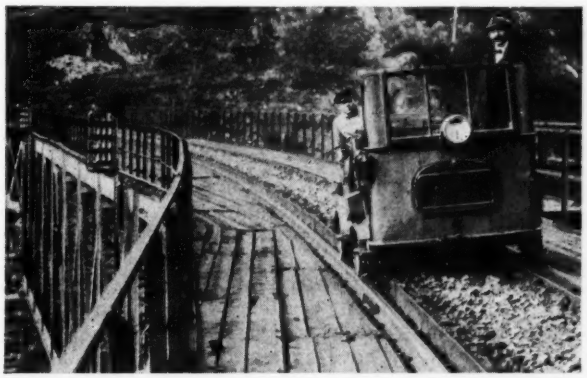
it is necessary in principle to consider two methods relating to the organization for the relaying of rail:

I.—With interruption of the traffic.

II.—Without interruption of the traffic, but taking advantage of the interval between trains.

On the double-track lines of the Belgian State railways temporary cross-overs are placed at each end at the nearest stations, and as soon as the daily task is done the normal traffic is resumed on both tracks until the next day.

Before the war, the Dutch State railways generally renewed the track on single-track lines at night when the interval between trains was longer and on double



An Austrian Supervisor and His Motor Car

track lines by stopping traffic on the track being renewed. At present, however, the work is done by distributing a certain number of new rails alongside the track, and changing out the rails one after another during the interval between trains. By this means no reduction of the speed of trains is necessary. When the new track differs from the old one, the renewal is accomplished by putting new ties between the old ones and then placing the rails on them so that the center line of the new track is on one side at a distance of about 10 in. from its final position. As soon as a section of line, ranging from 650 to 1,000 ft. in length, has been laid in this way, the old track is cut, and the portion of the new track that is ready is connected up at the two ends during suitable intervals between trains. The detached portion of the old track is then removed, and the new one is lined over into its final position.

Organization on the Danish Railways

The gang is composed of 30 workmen, and their daily output of work amounts to 2 meters (6 ft. 7 in.) per man.

The Danish State railways have adopted the following method when renewing tracks:

(a) The old track is moved to about 8¼ in. from the center line. All joints are adjusted in the curves;

(b) All the ties at the joints, as well as those that have been condemned, are changed for new ones, and the latter with about half the old ones are placed as nearly as possible in the position they will definitely occupy in the new track. The old rails are then fastened temporarily on these by means of cramps, each rail having two cramps for each tie;

(c) The new rails are placed in their final position, that is, about 8¼ in. from the old ones;

(d) The fishplates are then fixed;

(e) The tie plates are placed under the new rails and fastened to the ties in their final position, and the new rails are fastened temporarily by cramps to the other ties;

(f) The old track is cut and the new one joined up, after which the former is taken away and dismantled, the remaining ties which have not yet been definitely fastened in the new track are put in their proper positions, the surface of the track is adjusted, and the ties are tamped.

The number of men in the gang depends partly on the possibility of being able to secure a large number at the point where the work is done, and partly on the method by which the work is accomplished, which depends greatly on the intensity of the traffic on the section concerned. The total number of workmen varies generally between 25 and 40, distributed in different groups.

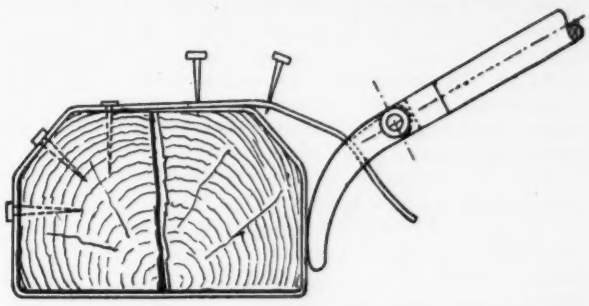
Groups of 4 to 6 men are employed on preparatory work such as removing the ballast, unscrewing bolts in the old track, distributing the joint ties and a few intermediate ties for the new track, and distributing the new material required, etc. In addition to these, other gangs are formed as follows:

14 to 20 men for renewing the rails, etc.;
10 to 20 men for renewing the ties;
8 to 10 men for adjusting purposes;
5 to 10 men for gathering up released material.

It should be pointed out that all these groups do not work simultaneously, but that workmen who have been engaged one part of the day in renewing rails, may be used later in the same day on renewing ties or taking away old material.

The average speed at which relaying is done generally varies between 2 and 3 lineal meters (between 6 ft. 7 in. and 9 ft. 10 in.) of track per day per man.

The Swiss Federal Railways make most use of the method of renewing the track, which consists of entirely demolishing the old one and building up the new track along the center line, using for this purpose gangs of 40 to 50 men. The daily result varies a great deal. For instance, in tunnels it amounts to about 2 ft., in the open to 2 ft. 3 in., and on secondary



A Device Used in Czecho-Slovakia to Overcome the Checking of Ties

lines to (4¼ ft.) per workman per day. In exceptional cases where traffic is heavy, the repairs are made piece meal.

Generally the speed of the trains is reduced over those portions of track that are being renewed, or when complete relaying is in progress. For instance, on the Belgian State Railways the normal speed is reduced to 12½ miles, on the Danish State Railways to from 3 to 15½ miles, on the Northern Railway of Spain and on the Italian State Railways to 4 miles, on the Dutch State and on the Czechoslovakian State railways to 19 miles, and on the Swiss Federal railways to 28 miles when using the continuous brake, and to 19 miles with the hand brake.

In order to insure the safety of the section on which relaying is taking place, portable signals are used according to the respective regulations of the railways interested, and whistles or horns are sounded to warn the workmen of an approaching train.

Most ties are bored before hand at only one end before creosoting, the other end being left to be bored on the spot, but where it is possible to connect up the ties mechanically at the place where they are treated, this is found to be the better way. Ties capable of being used over again are repaired at once, on the spot, after being taken up, or they are sent to the station, where they are repaired by mechanical means, a method which seems to be most in favor. Repaired ties are restored to service again as soon as possible, and those that are split are generally repaired by means of S irons.

It is the custom on the Belgian State Railways to strengthen the ends of all new ash ties by means of bolts ⅜ to ½ in. in diameter. Bands of flat iron are generally used by the Czechoslovakian railways for binding split ties. When the ties show signs of longitudinal splitting (especially those of ash), they are banded by means of a special lever with a strip of sheet iron 1 1/16 in. by 3/32 in., fixed about ⅜ in. from the end of the tie by means of five forged nails.

Congress Adopts General Conclusions

THE INFORMATION presented by the "reporters," together with the discussion of their papers, was summarized in the following conclusions which were approved by the Congress.

(1) The proper construction and drainage of the sub grade and road bed is a necessity of efficient maintenance work.

(2) The standardization of material is desirable for both technical and economic reasons.

(3) It is desirable to reduce as far as possible the time spent in periodical rounds of inspection.

(4) It is desirable, either on the knowledge gained by past experience, or by adopting some method of suitably distributing the various elements of maintenance work, to determine the proportion which should exist between labor employed and work done.

(5) Although the system of carrying out local maintenance work where found necessary is adopted on many railways, the majority of the "reporters" consider that the system of a periodical general overhauling is safer and more economical. The two systems are perhaps not so different from one another as might be supposed, both being based on the same principles, although in one case these principles are applied according to the necessities of the moment, while in the other they receive a more systematic application. In any case, both systems give excellent results in the hands of companies who know how to work them.

(6) The technical processes adopted in the different branches of maintenance work are not uniform. It would be useful if systematic experimental work could be undertaken with a view to determining the best methods of work applicable to each operation, taking into account the advantages to be derived from the use of mechanical appliances.

(7) It is essential for economic reasons to keep the ballast clean and free from vegetation; also to prolong as far as possible the life of the permanent-way materials; in particular, ties should not be scrapped before reaching their limit of wear.

(8) The obstacles encountered in Europe as regards the development of mechanical processes in routine maintenance work are generally of an economic nature; high cost of the mechanical equipment and inadequate daily output of the equipment resulting from the difficulty of co-ordinating mechanical work and manual labor on a given piece of work. These obstacles, however, are not met with in America, where considerable economies are effected by the use of not only small appliances such as tamping machines, but also of much more powerful machines, such as machines for screening ballast, leveling the track, etc.

(9) Motor cars (providing due regard is paid to regulations relating to the safety of running on the line) constitute an economic means of transporting men and materials.

(10) The grouping of maintenance personnel into gangs for work on long stretches of line, and the provision of rapid means of transporting the gangs (trains or cars), have generally given satisfactory results.

(11) The ordinary routine forms of maintenance work do not lend themselves to the contract system, and should be carried out by the permanent personnel of the railway, augmented where necessary by temporary employees.

For the more important work, the same system is still to be preferred, but in certain countries it has been found advantageous, either on account of economic reasons or because of the scarcity of labor, to have the work performed by contract, provided that contracts are placed on the result of competitive bidding.

(12) As the supervisor's trips are essential for the efficient control of maintenance work, their frequency should be facilitated by the provision of adequate means of rapid transport, in addition to visits on foot, which are of the greatest importance.

(13) The analysis of the various operations comprised in maintenance work, and the rational application of such analysis to the organization of the work, constitute a problem which calls for considerable further study. This question is intimately connected with the further question of the control of output, of bonuses, and of piece work. It does not appear that the investigations so far carried out in this direction have resulted in any general solution of the problem.

(14) The use of powerful mechanical appliances, such as those in use in certain parts of the British Empire and in America, may be expected to transform the technical aspect of the problem of renewals of the superstructure of the permanent way.

As regards the older processes, in which mechanical appliances play but a small part, it is desirable to determine by systematic research which are the best methods from the economic and technical points of view.

This class of work has been carried out either by the railways themselves or by contract, with satisfactory results; choice between the two systems is determined by the circumstances of each particular case, or by the conditions peculiar to the individual railway.

The Reservoir at St. Jo, Tex

Missouri-Kansas-Texas Improves Water Supplies

Comprehensive Program Extending Over System Shows Marked Results in Locomotive Performance

By J. H. Davidson
Water Engineer, Missouri-Kansas-Texas, Parsons, Kan.

THE IMPORTANCE of supplying locomotives with boiler feed water of proper quality has been recognized on the Missouri-Kansas-Texas for a number of years and this important feature has been considered in the location of new supplies. As a result there are on this railroad many supplies of excellent quality requiring no treatment whatever. However, in some parts of the territory traversed, supplies of suitable quality are not available and corrective treatment is desirable.

Prior to 1916 various boiler compounds were used and a few treating plants using soda ash were constructed, but the results obtained were not entirely satisfactory. The first important step toward water treatment was made in 1916, when a lime and soda ash softening plant was constructed at Osage, Okla., and filtration plants at Fallis, Okla., and Smithville, Tex. In August, 1917, the position of water engineer was established under the direction of the chief engineer.

A systematic study of all conditions affecting water supplies was begun at this time with especial attention to quality. All analyses which had previously been made were studied and a great many additional analyses were carried out. Care was taken to secure samples for analysis under different conditions to allow for seasonal variations and thus determine the best and the worst as well as the average quality of water from each supply. While this study was being carried on, situations requiring immediate action were handled with proper attention to quality and quantity of supply, so that considerable progress was made in the improvement of supplies.

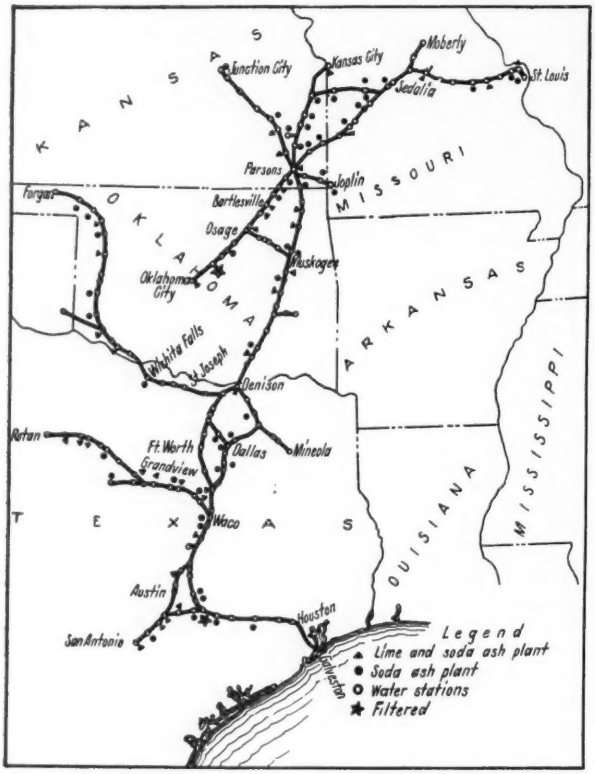
During a portion of the time that the railroads were under federal control, the M-K-T Lines were divided and this, for a short time, interrupted the program for water treatment. The work was actively resumed in 1920 and in April, 1921, a water softener was placed in operation at Oklahoma City, Okla. A year later the largest plant on the system, with a treating capacity of 50,000 gal. per hour and a storage capacity of 200,000 gal. of softened water in the treating tank, was placed in operation at Parsons, Kan. Locomotives operating between Parsons and Oklahoma City were now supplied with softened water at three terminals, Parsons, Osage and Oklahoma City, and at one intermediate point, Bartlesville, Okla., where water is furnished from a softener operated by the Santa Fe. The results obtained from these installations were so satisfactory that in the latter part of 1922 the construction of eight additional plants was begun and these were all in operation by February, 1923. Five of these plants are located on the Texas Central division, a branch line extending from Waco, Tex., to Rotan, where most of the water supplies are heavily impregnated with gypsum. These plants were designed by the water engineer and erected by company forces with the exception of steel settling tanks which were erected by contract. The other three plants, two of which were located in Oklahoma and one at Kansas City, Mo., were furnished and erected by the Graver Corporation.

A chart showing the mile post location and the spacing of water stations and a graphical representation of the average daily consumption and quality of the water was found to be a valuable aid in the study of the water supplies. Wherever possible supplies insufficient in quantity, poor in quality or improperly

located were replaced by good supplies. Notable examples are the reservoir at St.. Jo, Tex., with a capacity of 135,000,000 gal. and a drainage area of 1,725 acres, which replaced three supplies of insufficient quantity and poor quality; and a drilled well 200 ft. deep at Grandview, Tex., which replaced two very unsatisfactory supplies and provided a better spacing of stations.

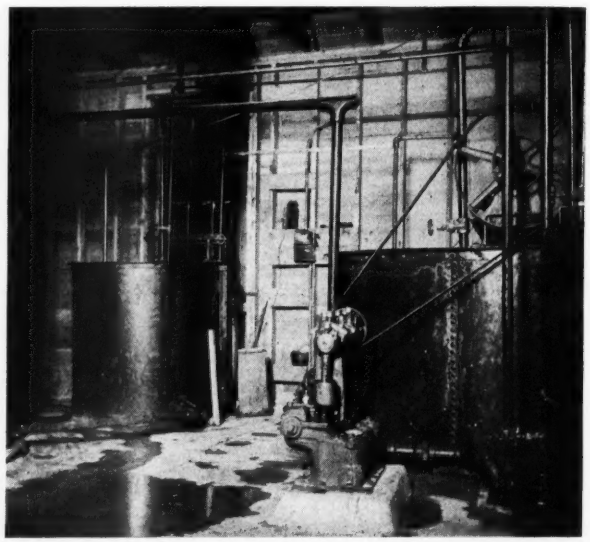
A Comprehensive Program Was Undertaken

With these preliminaries out of the way, estimates were prepared providing for sufficient water treating facilities so that all locomotive boilers would receive only raw water of such quality that no treatment is required, completely softened water, or water to which sufficient soda ash had been added to convert adherent scale-forming substances into soft slime. In arriving at a decision as to whether a complete lime and soda ash softener or a soda ash plant should be installed at a particular location, use was made of the A. R. E. A. formula for the value of one pound of scale-forming matter removed from feed water before entering the boiler. Eleven cents per pound was the figure used at the time these estimates were prepared and where the net annual saving, estimated by deducting operating costs from the gross savings, was 25 per cent or more of the investment required, a complete softener was recommended. There were, of course, exceptions to this rule which were controlled by other considerations. In submitting the estimates for approval emphasis was placed on the fact that the success of the program depended on the entire plan being carried out substantially as presented. Approval was promptly received.



Map of the Missouri-Kansas-Texas Showing Location of All Water Stations and Indicating Where Water Is Treated

Following the above plan, 24 complete lime and soda ash softeners and 52 soda ash plants were constructed. The contract for the 24 softeners was the second largest single contract ever let for similar equipment and the whole project, in number of water stations affected, was probably the largest ever undertaken by a railroad at one time. Specifications for the lime and soda ash softeners were prepared by the water engineer and the softeners were furnished and erected under contract by the Graver Corporation. They are designated as "Graver Type K" plants. They vary in capacity from 5,000 to 50,000 gal. per hour and are continuous, automatic, ground-operated, without filters. Three of the larger plants are provided with down-take agitation which is driven by a water wheel operated by incoming raw water. The other plants have a mixing chamber on top of the down-take. The settling tanks with one exception are of the flat-bottom, standpipe type, with a sludge collection system placed on bottom. This type of tank has proven entirely satisfactory and there has been no difficulty in the removal of sludge without excessive waste of water. The settling tanks are of sufficient height to deliver softened water by gravity to existing storage tanks. Five of the settling tanks provide storage space for softened water in addition to settling space.

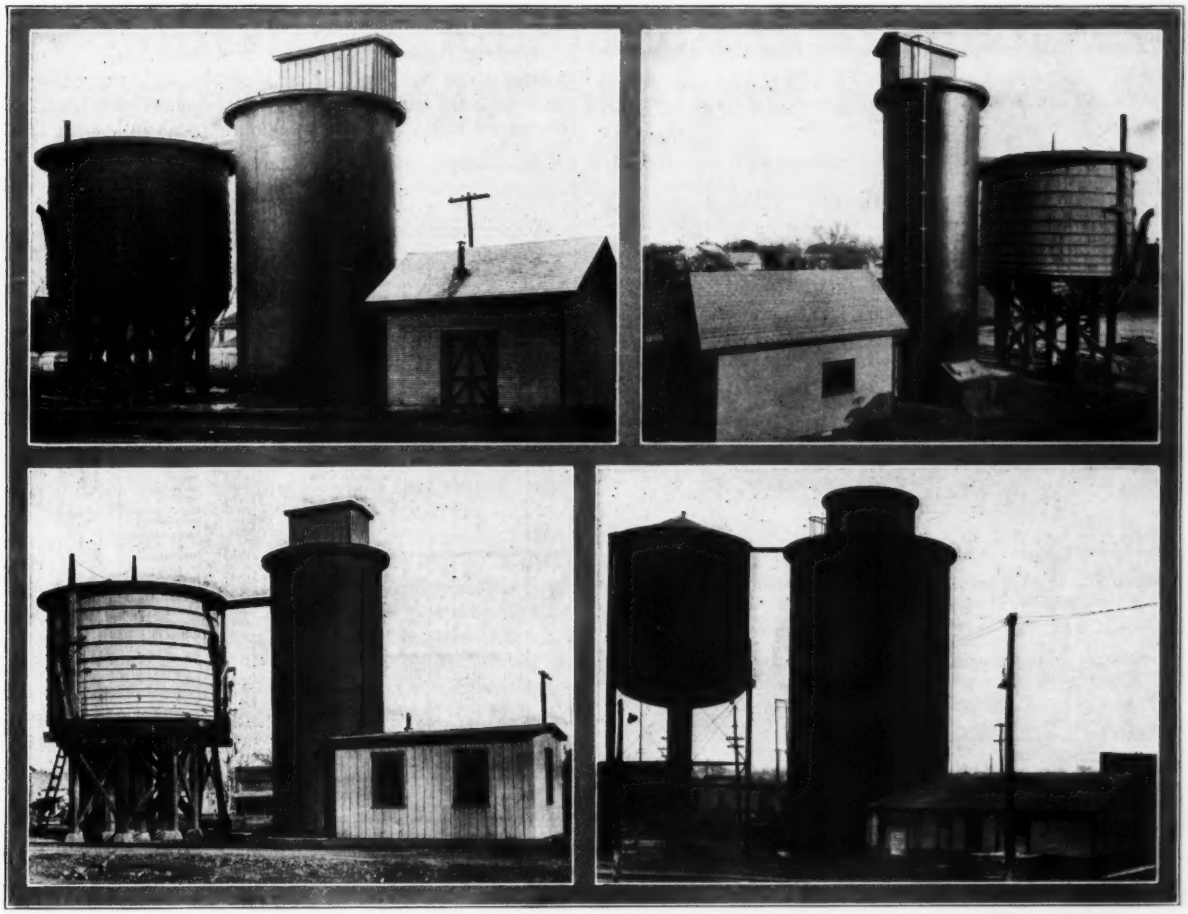


Chemical and Proportioning Machinery in the Graver Water Treating Plant at Oklahoma City

The foundations and housing were constructed by company forces. In order to expedite the work and decrease the cost of construction, only four standard sizes of houses were constructed and one set of plans covered them all. The houses are of frame construction with concrete floors and zinc shingles. They are of sufficient size to house machinery and provide storage space for at least 60 days' supply of chemicals. Lime and soda ash are purchased in carload lots and distributed to all but the larger stations by the supply train, under the supervision of the stores department, which makes a trip over the system once every 60 days. This method of supplying the smaller stations has been found to be economical and satisfactory in every respect.

The so-called "soda ash" plants which are used to inject sufficient soda ash to neutralize the permanent hardness into the water as it goes into the storage tanks, were constructed by two especially organized and equipped gangs. All material for these plants

was concentrated at central points and there loaded onto these outfits and the plants were completed and placed in operation in order as the gangs moved over the road. These plants are of various types depending on the source of water supply and method of pumping. Some of them consist of a soda ash solution tank and a small duplex steam pump with operation regulated by the pumper. Others consist of a soda ash solution tank connected into the suction of the water pump, the feed of chemical being regulated by a valve in the connecting pipe. At plants where city water is used or the tank is remote from the pump house, use is made of a Roberts duplex water engine which operates a small plunger chemical pump. This introduces the soda ash solution in proportion to the raw water entering the tank. Where additional housing was required for this type of plant, old car bodies were fitted up for this purpose.



Four of the Treating Plants in Service on the Missouri-Kansas-Texas

With the exception of one or two plants, all were completed and in operation by the close of 1923. The total investment in water treating facilities at the completion of this program was $281,843. This covers 35 complete softeners and 52 soda ash plants, constituting 60 per cent of the total number of water stations and softening approximately 65 per cent of all water used in locomotive boilers.

Organization Perfected for Plant Operation

The plants were designed to require a minimum of operating labor. Wherever pumpers are employed they look after the treating plants as part of their regular duties; at other points employees devote part time to this work in connection with other duties.

After the plants were completed and in operation the water engineer's work was placed under the supervision of the engineer maintenance of way. The water engineer has one assistant, one clerk and two inspectors. The division water service forces are responsible for the maintenance of the plants.

Samples of treated water are sent to the laboratory twice weekly from the lime and soda ash plants and once a week from the soda ash plants. Samples of raw water are sent in once a week from all plants. In addition to these tests the inspectors are continually making tests at the plants. From these tests the average incrustants in the raw and treated water are determined and in the case of the soda ash plants only the permanent hardness is considered removed. Complete records of all operating and maintenance costs are kept and a monthly statement is rendered, analyzing the costs on both a cost per thousand gallons basis and also on the basis of the pounds of incrusting matter removed. Since the cost of pumping water is always stated in terms of thousands of gallons, it is necessary to figure the cost of treatment in this manner also, but since the benefits of the treatment are based on the pounds of incrustants removed, a statement showing the cost of removing a pound of incrustants is quite valuable. At the end of the year an annual summary of results of operation is rendered.

A remarkable improvement in the number of boiler failures has been made since the treating plants were

installed and failures and delays due to leaking flues and fire boxes have been practically eliminated. Nearly all of the boiler failures the past year have been due to bursted flues. The average miles per boiler failure for the system in 1923 was 89,265. In 1924 it was 403,617 miles. The greatest improvement is on the Texas Central division where the incrusting matter in the raw water averages high. Five softeners were placed in operation on this division in December, 1922, and January, 1923, and two more softeners and four soda ash plants were installed the latter part of 1923. Total engine miles per boiler failure in 1921 were 23,823. In 1924 there was only one boiler failure (a bursted flue) with 982,748 miles. The following statement shows the miles per boiler failure for the system and also for the Texas Central division for 1921 to 1924, inclusive. The large number of failures during 1922 was partly due to conditions resulting from the strike.

STATEMENT OF BOILER FAILURES—MISSOURI-KANSAS-TEXAS LINES

Number of Failures		Locomotive Mileage	Avg. Miles Per Failure
1921			
Passenger	52	7,789,225	149,792
Freight	162	9,500,234	58,643
Total	214	17,289,459	80,791
1922			
Passenger	154	6,149,826	39,933
Freight	427	8,518,341	19,949
Total	581	14,668,167	25,246
1923			
Passenger	39	6,457,340	165,572
Freight	129	8,639,291	66,971
Total	168	15,096,631	89,265
1924			
Passenger	15	6,370,317	424,687
Freight	21	8,159,901	383,805
Total	36	14,530,218	403,617

STATEMENT OF BOILER FAILURES—TEXAS CENTRAL DIVISION

Number of Failures		Locomotive Mileage	Avg. Miles Per Failure
1921			
Passenger	9	387,486	43,054
Freight	28	493,965	17,641
Total	37	881,451	23,823
1922			
Passenger	54	315,548	5,843
Freight	107	539,025	5,037
Total	161	854,573	5,308
1923			
Passenger	10	390.099	39,009
Freight	11	550,700	50,060
Total	21	940,799	44,799
1924			
Passenger	None	410,819	410,819
Freight	1	571,929	571,929
Total	1	982,748	982,748

During 1923 a reorganization of operating districts was made and many changes were made in the assignment of power. These facts, together with the fact that it usually takes two years or longer for a locomotive to run out its flue mileage on this road, have made it impossible to secure a comparative statement at this time showing the average increase in life of flues and fire-boxes on the system for all classes of power. A group of heavy passenger engines received new in 1920 and 1921 made an average of 120,000 miles with the original set of flues. With the second setting this mileage was considerably increased. Another group of practically the same class were received new in 1923 and made an average of over 150,000 miles with the original set of flues.

On the Texas Central division before the water was treated a new setting of flues usually lasted only eight months and required continual working. They are now lasting two years and require very little work. Fire boxes frequently had to have new sheets after eight to twelve months' service with heavy maintenance charges in the meantime. With the use of treated water at least five years' life is anticipated for these fire boxes. The records to date show that flue mileage on this division is about three times greater since water treating plants were placed in operation. It is estimated that the annual saving per locomotive per year on this division in fuel and boiler repairs due to improved water conditions is at least $3,000.

Improved Operation Evident

Due to the relatively large number of soda ash plants in operation it is necessary to do some blowing off of engines on the road to keep down the concentration of suspended matter and foaming salts. On districts where the foaming salts are high an anti-foam boiler compound is used. The amount of fuel saved by having heating surfaces free from scale is much greater than the amount wasted through the blow-off cock and the fuel record for 1924 was excellent. As compared with 1923 on a passenger car mile and 1,000

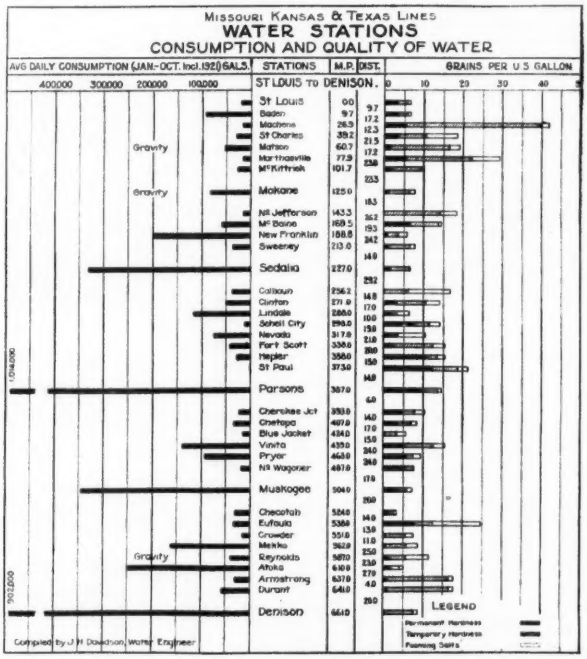


Chart of Water Consumption and Quality on One Main Line Route of the System

gross ton mile basis, there was a decrease of approximately 10 per cent for passenger service, 14 per cent for freight service and 6 per cent for switching service. This decrease in fuel indicates a saving of approximately $470,000 for the year. During 1924 all locomotives except those operating between Franklin, Mo., and St. Louis, were oil burning and made the following record for the year:

PERFORMANCE OIL BURNING LOCOMOTIVES—1924

Passenger		Freight	
Locomotive miles	5,652,607	Locomotive miles	5,116,471
Passenger car miles	37,767,606	Gross ton miles	8,109,996
Gallons oil	41,314,088	Gallons oil	88,916,537
Cars per train	6.7	Tons per train	1,585
Gallons car mile	1.09	Gallons 1,000 G.T.M.	11.0

This record compares very favorably with that made by other roads operating in this district. While a great many factors enter into the saving of fuel, such as heavier train load, better firing and better shop work, the improvement of the water no doubt contributed materially in bringing about this decrease.

The improved water conditions have helped to make possible the long continuous engine runs that are now being made on this road. Freight locomotives are being run from 275 to 343 miles continuously and passenger engines have been regularly in successful operation on a continuous run of 869 miles.

The formula developed by the Water Service committee of the American Railway Engineering Association to determine the saving effected by softening water before it enters the locomotive boilers, takes into account only the savings in fuel and repairs, life of flues and fire boxes and engine time while such repairs are being made. There is a saving in transportation expense, which is rather difficult to determine accurately, but which at times may be considerable. Take for example the case of boiler failures. These result in tonnage standing still while the cost of operation continues, generally at the rate of time and one-half for labor. Quite often to this is added the expense of sending another engine out after the train. In addition to the elimination of boiler failures the effects of better steaming engines that are capable of getting full tonnage over the road are an important factor in the reduction of transportation expense. The operating statistics for the M-K-T Lines for the year 1924 reflect efficient operation and the figures indicate that the improvement of the water supplies has been an important factor in obtaining these results.

Voluntary Examination of Employees Encourages Study of Rules

FOR THE purpose of encouraging a study of its book of rules and instructions to maintenance of way employees, the Nashville, Chattanooga & St. Louis has established a system of periodic examinations in these rules. The examinations are open to all employees of the department but are purely voluntary, no employee being required to take part who does not wish to. However, the interest which the men take in these examinations is indicated by the fact that 277 employees submitted answers in an examination held last year. Of these, 147 section foremen, or 90 per cent of all the foremen employed on the railroad, filed papers. Others included 20 assistant foremen and 56 section laborers, besides bridge and building supervisors, foremen, assistant foremen and mechanics; extra gang foremen; water service foremen and assistant foremen; signal supervisors and others.

In addition to the advantages gained through a more thorough knowledge of the rules obtained by the incentive offered for their study, the examination has afforded the railroad an effective means of identifying the intelligent, wide-awake men in the organization. Needless to say, the foreman, assistant foreman or laborer who makes a good showing in the examination will receive due consideration when opportunities for promotion occur. As a facility to this end the examination paper provides blanks covering the age, experience and service record of the man who files it.

The examination paper constitutes a 12-page and cover form known as Form No. 718, and is issued periodically with the necessary revisions to provide an entirely new set of questions such as the following, which were contained in an examination paper issued last year.

A Typical Set of Questions

1. What obligations rest upon each employee?
2. To whom are you required to report under our organization? What does the word "report" as used above mean?
3. What are special instructions and how are they to be treated?
4. What requirements are to be observed in employing new men or considering men for promotion?
5. What are your duties in connection with the following: (a) Training of men for promotion? (b) Dealing with subordinates? (c) Maintenance of discipline?
6. What precautions must employees observe to protect themselves and others against injury?
7. What kinds of communications are required to be in writing?
8. What must employees do when trains are passing their work?
9. What are your duties with respect to the following matters: (a) Throwing switches and derails? (b) Clearances? (c) Delay to traffic? (d) Keeping correct time? (e) Signaling appliances for which you are responsible?
10. What are the duties of a flagman protecting a moving hand car?
11. What are the foreman's duties in connection with moving his hand car over the road?
12. What are visible signals?
13. What are audible signals?
14. What are automatic signals?
15. What is the meaning and object of interlocking?
16. What are the section foreman's duties in connection with signal apparatus and interlocking plants?
17. What are the duties of extra gang foremen in connection with signal apparatus and interlocking plants?
18. What are the duties of a bridge and building foreman in connection with signal apparatus and interlocking plants?
19. What are your duties when conditions require the use of stop signals?
20. What are your duties when conditions require the use of caution signals?
21. What are your duties with respect to the following: (a) Care of tools and material? (b) Track walkers? (c) Flagmen? (d) Speed of trains? (e) Care of ties? (f) Why must good line and gage be maintained? (g) Why must track on curves be maintained to proper and regular elevation, and why must track on tangents be kept level? (h) Why is it important to keep nuts tight? (i) Of what importance are rail anchors? (j) Of what importance are tie plates?
22. When should track be overhauled?
23. Assuming that all tie renewals are to be made upon a one-year term and patching plan, and that you were counting the ties to come out as per Rule 415, what consideration would govern your judgment in making such a count?
24. What are your duties in connection with the following: (a) Care of right-of-way? (b) Company property? (c) Sanitary regulations? (d) Work trains? (e) Laying new rail? (f) Looking out for defects in rails?
25. What are your duties in connection with the inspection and maintenance of bridges and buildings?
26. What are your duties in connection with water supply?
27. What are your duties in connection with locomotive cranes, ditchers, pile drivers, etc.?
28. What do you consider the most essential features of first aid?

It will be noted that most of these questions call for some answer from an employee of any branch of the maintenance of way department, but that some of them are of far greater importance to the men of one branch than to those of another. For example, certain questions are of particular application to the track department and others, while they call for certain answers from a section foreman, require much more detailed answers from a bridge and building foreman or a water service foreman. This lack of balance in the importance of the questions to the

members of different branches of the department is adjusted by including in the examination form a table showing the relative values of each question for four classes of employees, namely, track employees, bridge and building employees, water service employees, and machine operators and helpers. All questions are accorded some value for the track employee, but certain of the questions being of minor consequence to employees of the other three classes are given no value for them. However, the rating for the questions under each classification has been adjusted to total 100 per cent for the questions applying to that class of service.

How the Examination is Announced

Notice of the examination is made by means of a placard posted on all tool houses, a typical one being reproduced in part below.

NOTICE TO MAINTENANCE OF WAY EMPLOYEES

Form 718, Written Examination for Maintenance of Way Employees, has been revised and copies are ready for distribution to all employees who desire to submit answers to the questions contained therein.

Employees below the rank of foreman who have not had access to the book of rules can secure a copy by applying to their foreman. No employee is required to answer the questions, but all desiring to do so are given the opportunity. When the foreman's book is not sufficient for the use of all desiring it, he must apply to the division engineer for additional copies.

The best set of answers submitted by any employee on each division will be published in the Bulletin as space permits, and the names of foreman and men in different subdepartments on each division who present the best and next best answers will also be published.

Blank lines are left after each question upon which the answers must be written by the employee making the answers, in his own handwriting.

All blank forms furnished to employees must be receipted for and returned whether filled out or not. Each rule book must also be returned.

The time for filing answers has been extended to May 1.

All answers submitted must be forwarded to the division engineer in the same envelope in which the form was received. The envelope on the return must be sealed.

All answers submitted on each division will be passed upon and graded by a committee of the officials of that division. The papers selected as the best and second best by these committees will be forwarded by the division engineer to the chief engineer and the best of these will be determined by a special committee of officials appointed for the purpose.

HUNTER MCDONALD,
Chief Engineer.

Some of the Answers Are Published

The bulletin mentioned in this notice is the monthly publication issued by the Nashville, Chattanooga & St. Louis for the benefit of its employees. The fact that the names of the employees receiving the highest grading in the examination, as well as answers to the questions, are published in this bulletin adds not a little to the incentive for taking part in the examination. Specimen answers appearing in one of the issues of the Bulletin follow:

No. 6. What precautions must employees observe to protect themselves and others against injury? "Each employee is responsible for his own safety and must take care not to injure others. They must stand well clear of tracks while trains are passing and know that all appliances and tools are in safe condition before using, take prompt action in an emergency to prevent accident, keep on the safe side and do not take any chances."

No. 21. What are your duties with regard to the following: (a) Care of tools and material? "Keep tools under lock and key when not in use. Keep a check on all tools and material to see that none is lost or stolen. Do not loan material or dispose of it in any way except in work for the company." (b) Track walkers? "Employ only reliable and experienced men as track walkers. See that he carries the required tools and flagging equipment and understands flagging rules. Go over the section with him once in a while to make sure that he knows how to do his work." (c) Flagmen? "See that they are provided with proper signals and understand the flagging rules. Caution them not to sit down at their posts until recalled or relieved." (d) Speed of trains? "Report all trains that do not reduce speed or acknowledge caution signals, slow orders, etc., according to rules and instructions." (e) Care of ties? "Distribute ties as near the place they are to be used as possible. Do not let them lie on ground long enough to be damaged. If delivered ahead of the work, put them in piles. If treated ties are damaged or adzed so that untreated timber is exposed, apply hot creosote with a brush. If a pick is used with untreated ties, stick it in the side of the tie. Do not use a pick if tie tongs are on hand. On tracks where cinders from engines are dumped, cover the ties with two inches of clay if no other means are provided to keep them from being burnt."

No. 25. What are your duties in connection with the inspection and maintenance of bridges and buildings? "Foremen of bridges and buildings report to and receive instructions from the supervisor of bridges and buildings. They are responsible for the proper execution of all work assigned them by the supervisory officer and for the proper care and use of tools and material assigned them for the execution of their work. They must keep up the supply of necessary tools and material by making requisitions in ample time. They must see that the men in their gangs properly perform their duties. They must make inspections of structures and the necessary repairs to them as directed by their supervisors and report conditions found and work done on the proper forms. They must see that bridges and trestles are in good line and surface, with bolts tight, anchors, track spikes and track bolts in place, shims on trestle work sound and secured in position, caps bearing on piles. Note all motion of members under traffic and as far as possible remove rotted sap wood and decayed timber. They must keep the division engineer and supervisor advised of their location. They must keep and report on the prescribed forms the time of their men. They must show the days worked, labor, expense and material used on each class of work."

No. 26. What are your duties in connection with water supply? "To see that a sufficient supply of water is available for locomotives at all watering stations at all times. To inspect all water stations from time to time and see that everything is in good working order, and in the proper state of repair. To see that assistant foremen of water supply, pumpers and all men employed in the water supply department discharge their duties properly. To keep in as good repair as possible all apparatus under the jurisdiction of this department. See that all stand-pipes and tank fixtures are maintained at proper clearance. Check and O. K. all bills for water and electricity used by this department and such other bills as requested. See that tanks are cleaned up as often as conditions require. Test boilers. Look out for the company's property and interests."

Some Important Requirements For Good Concrete

How Time of Mixing, Proper Speed of the Mixer, and Manner of Curing Affect the Quality of the Product

By A. M. Bouillon
Engineering Department, Illinois Central, Chicago

MORE HAS been written on the subject of concrete than about any other building material. From the days of the Roman Empire, engineers who built monuments with concrete that has stood the wear of 20 centuries, wrote of the wonderful results obtained with a mixture of volcanic sand with lime and rubble that hardened equally well under water and in air. This is all the more remarkable, because the Romans knew practically nothing about chemistry. They merely applied certain discoveries, obtained originally from the Greeks, and through practical experiments found a way to develop the best possible cementing combination with natural elements.

In spite of our better cement and more thorough knowledge of mixing and placing concrete, many engineers and contractors still fail to apply the lessons taught by the Roman engineers. The Romans aimed to produce results in terms of centuries of service, whereas we, in many cases, are concerned primarily with the production of a certain cubic yard output per day. They, in spite of the handicap of crude methods and a variable quality of their natural cements, built structures that have stood the test of time, while we, with far superior opportunities have not, as a general rule, produced a quality of concrete in keeping with the progress made in this field.

It is entirely possible, with the use of the best cements and aggregates properly measured, graded and mixed in an approved machine, and placed in the forms in accordance with accepted usage, that the resultant concrete will give only half the potential strength obtainable with the combination of materials as measured. This may result from all or any one of certain deficiencies, all of which, fortunately, are easily remedied.

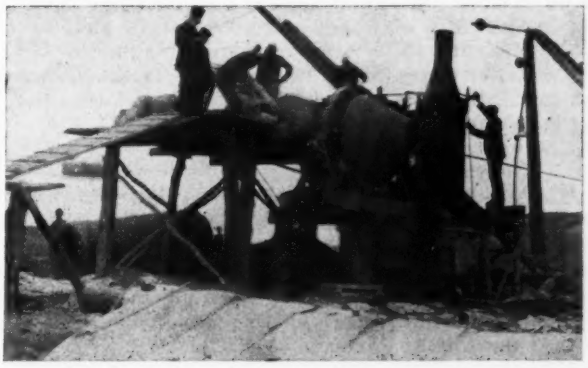
Insufficient Time Allowed for Mixing

One of the capital sins of the concrete industry is a failure to allow an adequate time for mixing. That the strength of concrete increases with an increase in the time of mixing up to a certain limit has been known to European investigators for many years and has recently received serious attention in the United States and Canada. Tests made by P. Steinbruck (Germany) in 1901 showed an increase of about 20 per cent in the tensile strength of sand mortars in 28 days, when the time limit for mixing was raised from 1½ min. to 5 min. Field tests made with standard tension machines on bridge work in Canada supervised by the writer gave somewhat higher results. The difference might perhaps be explained by the fact that we used a medium quick setting cement, with the probability that Steinbruck used the slow setting cements as was the general practice in Europe at that period.

Assuming the first minute of mixing to represent 100 per cent the gain in strength obtained by two additional minutes, based on our 28-day tests, averaged 20 to 25 per cent, the next two minutes (total 5 min.) added 8 to 12 per cent, the next two (total 7 min.) added 4 to 5 per cent and the next two minutes (total 9 min.) added 1 to 2 per cent. Compressive tests made at the Structural Materials Research Laboratory (Lewis Institute) under the direction of Professor D. A. Abrams, the summary of which is shown on a chart in one of the pamphlets published by the Portland Cement Association, are still more complete and impressive, showing a high gain up to five minutes of mixing after which the ratio of increase becomes rapidly less and that, in general, the strength is increased about 10 per cent by doubling the time through the range from 15 sec. to 10 min.

Speeding Up the Mixer Is Worse Than Useless

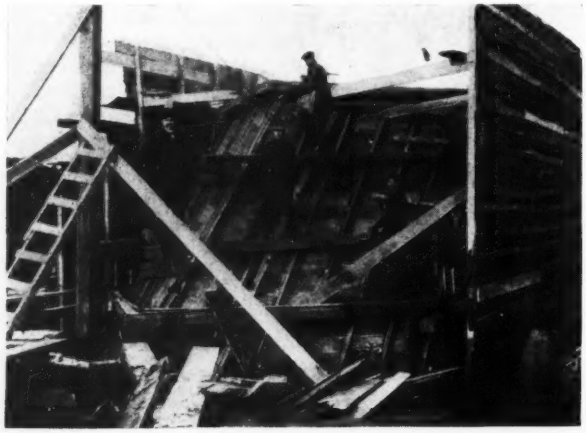
Accelerating the speed of the mixer drum so as to increase the number of revolutions, with the assumption that "the quicker it goes the better it mixes" is a pure delusion. Proper mixing requires time, but also exacts a rotating speed that will enable the mixture *to fall* when the centrifugal force has carried it to near the top of the drum. This force should never be sufficient to carry the bulk of the materials and hold them against the outer shell with little opportunity for individual movement of the various elements in the mix, except the water. The writer recalls instances, principally with small mixers that had been speeded up to an unreasonable limit because the specifications had called for a certain number of revolutions per batch and where dry materials were forced back of the paddles and held there, coming out unmixed and practically dry when the batches were emptied.



Speeding Up the Mixer Is No Substitute for Adequate Mixing Time

On bridge foundation work on the Grand Trunk Pacific of which the writer had direct charge, we decided to mix batches three minutes and not exceed 10 to 12 revolutions of the drum per minute, the latter depending on the size of the mixer, those in use on these jobs varying from ¾ to 1 cubic yard capacity per batch. (Smaller mixers can be speeded more in proportion to their drum diameter). The three minute batches included time of

loading and discharging, leaving a net average of over two minutes of actual mixing after the materials were all in. The extra time not only insured better concrete but insured almost entire freedom from breakdown of the mixer because it was used at its regular speed and gave the men handling the mixers more opportunity to watch



Housing in the Forms Insures Protection from Freezing and Affords Opportunity for Curing with Steam

their machines and look after the parts that might need attention. There were no tie-ups or delays due to breakdown of any of the mixers in spite of the fact that on one of the jobs the work was carried on night and day. Proper mixing requires time. Over-speeding of the mixer never saves time but invariably makes poorer concrete. Speeding also invites costly breakdowns and serious delays.

Too Early Removal of Forms

The second sin is the premature removal of forms and applies to concrete construction under every climate and during any season, but particularly during extremes of hot or cold weather. If left in place for at least two weeks, the forms will assist very materially in preventing evaporation of the water in the concrete. Water in proper measure is to concrete what blood is to animal and sap to vegetable life. It is the elixir that activates the cement and builds the strength of the mass. Without it, cement is inert the same as the aggregate. The hardening process requires sufficient moisture to complete the hydration of the active cement in the mixture. This process may continue for several months, depending upon the kind of cement, whether slow or quick hardening, the water proportion, the temperature of the mixture and of the surrounding air, etc. But concrete made with the average Portland cement will have attained approximately 48 per cent of its possible ultimate strength at the age of 7 days, 60 per cent at 14 days, 64 per cent at 21 days and 67 per cent at 28 days. The increase between the first and the third month is proportionately slow and will amount to about 13 per cent additional giving 80 per cent of the potential strength at 90 days. The above percentages will of course vary more or less according to different conditions of the mix, the materials and the methods of testing but probably represent a fair average.

From the above it will be noted that 60 per cent is gained during the first two weeks and about two-thirds during the first 28 days. These results are of course based upon the assumption that the concrete has been protected during the period of hardening so as to prevent losses due to evaporation of the moisture in the mix needed there to produce the expected strength. This is why the writer recommends keeping the forms on for at least two weeks in addition to the use of water for curing, to be discussed further on. The forms not only protect the concrete against the drying effects of sun, wind and artificial heat, but also act as a container for the film of curing water seeping between the face of the concrete and the forms. The forms will retain moisture for a considerable period in case of a breakdown in the water supply or where only occasional sprinkling can be arranged as in arid or semi-arid districts where water may have to be obtained from long distances and must of necessity be used with economy. Lack of protection against losses by evaporation results in a substantial weakening of the concrete, that might amount to half or more of the potential strength and one-third of the wearing qualities as in concrete pavements.

It is still the custom on many concrete jobs to permit the removal of forms in three or four days, and in some cases in even less time. This is particularly the case where steel forms are employed because of the desire to re-use them as often as possible so as to obtain as high a percentage of use on their investment as can be provided by improvident specifications or by too lenient interpretation of their clauses. When faced with the necessity of removing forms earlier than is desirable, the structure should be protected with heavy canvas and a satisfactory system for water curing provided. In all cases the exposed top, where there is no form, should be well covered and kept wet during the full period of curing.

The Effect in Winter

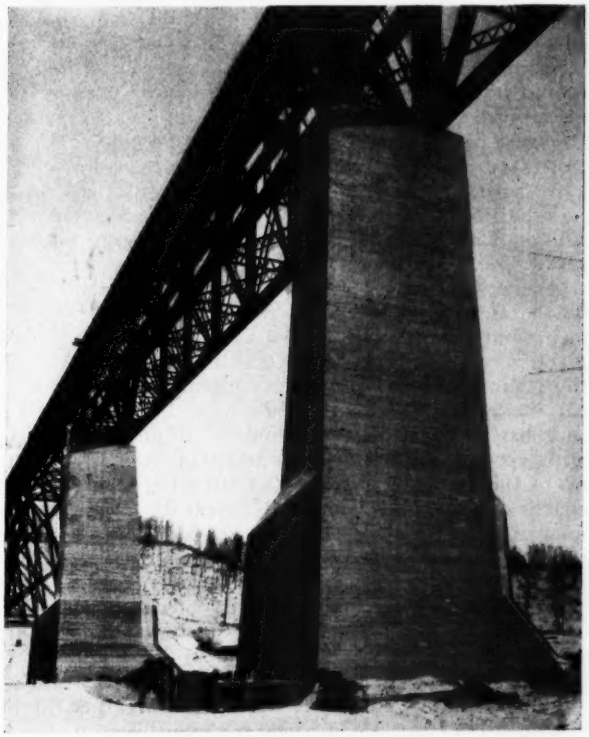
The effect of too early removal of forms during winter construction is equally as bad as in summer although

Forms Should Not Be Removed Too Soon

for a different reason. The evaporation is less, as it is retarded by the cold weather which also checks the process of hardening, probably stopping it near the face and in decreasing proportion toward the center. As quite a little heat is produced within the concrete while hydration goes on, reaching to about 100 deg. F. independently

of any heating of aggregates (or 30 deg. to 40 deg. above the assumed temperature during mixing), the sudden cessation of artificial heating, coupled with the removal of the forms, exposing an incompletely hardened concrete to an abrupt change of temperature of possibly 100 deg. or more, causes uneven stresses. These are particularly active on the faces, and produce numerous small cracks which may appear trivial but which in the course of time will gradually extend their depth and range according to their particular exposure to the elements.

These cracks will often retain water during driving rain and if wet weather is followed by fairly severe frost a mechanical action is created tending to extend these cracks still further. The writer has seen examples of such in retaining walls, piers and building foundations



An Example of Winter Cured Concrete

which in the course of years had been gradually weakened as a result of lack of proper protection during the early hardening stage. In some cases where concrete was exposed to dampness, moss had grown into the cracks, thus providing another destructive agent. Frequently discoloration follows the cracks and gives the concrete an ugly, unhealthy and weak appearance that suggests poor work and creates the impression that concrete is not a lasting construction.

Winter curing of concrete can be effected by allowing steam to escape from coils or radiators as was done by the writer on work in Canada. Where the winters are less severe, or, where drainage can be provided without the danger of ice forming on the housing, proper curing can be insured by a steady or occasional sprinkling of the top and saturation between the forms and concrete. On winter concrete construction carried out under the direct charge of the writer in Canada no forms were removed in less than one month and none was removed during extreme cold spells. This did not, as a rule, increase the cost as in most cases the forms were not re-used on other piers and could be left on until the end of the job. On this work it was not found economical to re-use wooden forms for bridge piers but some saving was made in re-using forms of pedestals when these were of uniform size and those for other concrete work where they could be designed and built as panels and put together with bolts and cross rods. However, the value to the structure of keeping the forms in place during the early portion of the hardening process far exceeds any gain made by frequent re-use of panel forms.

Failure to Provide a Supply of Curing Water Is Another Prevalent Sin

Another surprisingly prevalent sin is insufficient curing water. In spite of the information and recommendations that have been published for several years on this subject by many concrete investigators, the dangers attending a failure to provide enough curing water apparently not yet been generally realized except in highway and city pavement work. There are still many important plain and reinforced concrete jobs such as the building of retaining walls, buildings, bridge substructures, reinforced concrete viaducts, etc., on which no curing is provided. On the other hand we find that many cities and highway commissions appreciate the importance of curing concrete in their pavements. The specifications of the city of Seattle, Wash., provide that "the contractor shall keep the pavement wet continuously for 30 days and closed to traffic for 60 days after laying."

One of the pamphlets recently published by the Portland Cement Association draws particular attention to the important benefits derived from protecting concrete against evaporation while hardening, popularly known as curing.—These tests show that concrete kept damp for the first 10 days increased the compressive strength 75 per cent, for 3 weeks 115 per cent and for 4 months, 145 per cent.

The necessity of curing concrete should be emphasized in the specifications and made just as strict a requirement of the job as any other important part of the work. The approved method of curing and the period during which it must be continued should be stated specifically, and not in a general clause, such as always lead to argument and provide a channel for "passing the buck."

Curing can in most cases be done at a trifling cost and in no case at a heavy cost. It does not mean adding to the strength of concrete but *keeping the strength in that was placed there during the mixing* and for which the maker or owner is paying. C. H. Desch (U. of Glasgow) says: "One of the factors which influence the strength of the mortar is the amount of moisture in the atmosphere in which setting takes place. A decrease in the relative saturation of the air from 80 per cent to 50 per cent lowered the strength from 22.6 to 20 kilograms."

The above difference in strength amounted to 13 per cent for 30 deg. difference of moisture in the air. Competent curing measures would naturally protect concrete against any change in saturation of the air. Keeping the concrete faces wet prevents evaporation of the moisture within the concrete. Damp weather, particularly rain or heavy fog, is a valuable ally, but cannot be counted on. Dry air is thirsty for moisture and will draw it out of fresh concrete, even through the forms, but much more rapidly after the forms are removed, particularly during the early stage of the process of hardening.

The weakening effect of absorption of moisture from the concrete is particularly felt in the first two to three inches from the outside faces and varies, or encroaches further in, according to the intensity of harmful conditions. However, this is just that portion of the concrete which is expected to protect the mass, and, in

the case of reinforced concrete, is frequently the portion that takes the most severe concrete stresses, even though the outside 1½ in. or 2 in. layer was added only to protect the reinforcement and was not calculated as a strength factor.

Many engineers and contractors are more concerned about the smooth appearance of the concrete faces than they are about avoiding the serious losses of strength that invariably result from lack of curing. Smooth appearance is important and should be insisted upon, but it is neither a proof of strength nor of endurance. The trouble with our construction system as compared with that used by the Romans 2,000 years ago is that while we possess considerably more knowledge, we employ too little of it in many instances.

The writer considers that the minimum period of curing for structures such as retaining walls, bridge piers, abutments and pedestals should be two weeks, for reinforced concrete three weeks, for concrete pavements, four weeks.

Methods of Curing

A. *On flat surfaces:*

1. Sprinkling (constant is preferable), with ½-in. lateral pipes perforated about every foot with 1/16-in. to ⅛-in. holes drilled on angles in different directions. The spacing of the pipe depends on the pressure from the jets. The laterals should be fed by a main pipe of dimension in proportion to the number of lateral pipes located along the center. This method gives the best results and avoids staining the concrete.
2. Puddling and ponding water to a depth of at least two inches.
3. Spreading at least one inch of sand and keeping it wet.
4. Frequent sprinkling under a canvas that is kept damp.

B. *On side surfaces:*

1. Keeping the forms on during the full period of curing and allowing curing water applied at the top surface to flow between the forms and side surfaces.
2. If the forms must be removed before the full curing period has elapsed, hang canvas covers about six inches from the sides and let the curing water flow down from perforated pipes at the top. This flow can be so regulated that evaporation will absorb most of the water before it reaches the ground so that drainage does not have to be provided. This might require particular care in winter due to the formation of ice at the bottom if water is used for curing instead of steam.

C. *Curing under winter conditions:*

1. The escape of steam from the steam heating coils between the forms and housing provides the best means of curing as this keeps the forms moist and this moisture prevents the escape of moisture from the concrete. The forms should be kept on at least one month and no forms should be removed during periods of extreme cold weather. The housing can be removed in ten days to two weeks when heating and curing are discontinued. Very little evaporation of moisture in concrete takes place during freezing weather but curing must be kept on during the period of heating so as to offset the drying effect of artificial heat. Curing should begin 18 to 24 hours after the concrete has been placed.

Some Hints on Surfacing Tar Bound Platforms

By M. E. Kent
Foreman Mason, New York, New Haven & Hartford, Westerly, R. I.

WITH THE coming into general use of various kinds of tar as a binder for trap rock for surfacing station platforms, many who are charged with the actual supervision of this work find that they are somewhat handicapped in spite of the information distributed by the manufacturers. Thus the personal experience of men in the field becomes of help as it enables others to know the results obtained elsewhere.

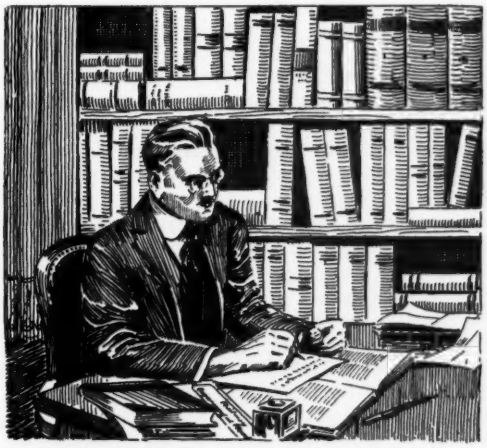
In working with this class of material, it must be kept in mind that any tar-bound surface is flexible under traffic and that it will settle and bend to take the same shape as the sub-grade. Therefore no platform can be better than its foundation. This cannot be emphasized too strongly.

When an old wooden platform is ripped out, all of the decayed wood and loose trashy material that is usually found around such places should be removed and a cinder fill placed and thoroughly tamped. No hand roller can do as good work as tamping irons. Each six inches of fill should be tamped before more is added. It is doubtful if a solid and permanent sub-grade can be established unless this or a similar procedure is followed. The top surface of the sub-grade should be finished to conform to the exact elevation and crown wanted on the finished platform and should be just as smooth with no hills or hollows. It should be kept 1½ in. lower than the finished platform and in securing this top surface for the sub-grade, a template should be used, not guess work. The sub-grading is the all-important thing about a tar-bound platform and the more carefully this work is done, the easier it will be to spread the top surface and to secure good results.

A spread of 2 in. in depth for the finish is about right; there is nothing to be gained by using more. This spread will settle about ½ in. after being used a short time. The stone to be used should be screened whenever necessary in order to free it of sand and dust. One-half to three-quarter inch trap rock should be used and mixed with the tar as recommended by the manufacturer. If Headley No. 1 is used as a binder, the stone should be wet before mixing as this makes the work easier and more thorough. After the mixture has been spread, it should be sprinkled liberally with very coarse, clean sand and then rolled. When oil of this general class is used, an additional or seal coat is applied, preferably on the next day. For this a quantity of tar is mixed with an equal amount of water plus sand and the completed mixture swept across the platform, completely filling all surface voids. This should be allowed to dry an hour or two, if possible, and then sprinkled with enough dry sand to keep it from being sticky, following which the platform is complete and ready for use. For best results work of this nature should be done during hot weather.

The use of this class of oil also bids fair to be a decided success when used as a wearing surface for overhead highway timber bridges. On the New Haven, it has been applied in the following manner with good results. The bridge floor was first swept clean and the tar poured on with a dipper. A man with a broom followed, spreading the tar out to a depth of from ⅛ in. to ¼ in. Very coarse sand was then spread over this to a depth of about ¼ in., and the bridge immediately opened to traffic. The automobiles mixed up the sand and tar very completely, more sand being added where needed. On the second day, a second application of tar and sand was made, following the same method used for the first. As soon as this was mixed up and rolled down by the traffic a good wearing surface about ½ in. deep was secured. In some cases, a little more sand is needed on the next day. This is especially true if the bridge is used by vehicles having steel tires. Where the traffic is light only one heavy application is needed, as this gives all of the protection necessary. Owing to the fact that the tar and sand do not get as much mixing as they do where the traffic is heavy, the appearance of the surface is not as good as it is on the others but the protection is there nevertheless.

What's the Answer?



This department is designed to serve as a reader's service bureau, wherein the many problems which arise in the routine maintenance of tracks, bridges, buildings and water service facilities, may be subjected to frank and thorough discussion. The value of the service thus rendered is proportionate to the extent to which readers avail themselves of it, in submitting questions and in lending their co-operation by offering answers to the questions presented.

Questions to Be Answered in October

1. *What rules should be followed to insure the oiling of motor cars?*

2. *What precautions must be taken in blocking up a weak girder span on temporary bents to make it safe for traffic until it can be replaced?*

3. *How frequently and in what manner should a foreman make a detailed inspection of the rail in his main tracks for indications of failures?*

4. *When renewing an old shingle roof with composition roofing or composition shingles is there any objection to applying the new roofing directly over the old?*

5. *Is it possible to repair a leaky water or steam valve in service and thus avoid replacing it with a new one?*

6. *Should second hand track bolts and spikes be used in main tracks?*

7. *What evidences of distress or deterioration may be noted in a hoisting cable as indicating that it ought to be replaced?*

8. *Is the installation of a line of drain pipe under the curb of a station platform advisable as a drainage measure? At what minimum depth should it be placed to avoid danger of breakage?*

Foremen for Work Trains

Should foremen be specially selected for work train service? Should the roadmaster or his assistant make it a practice to accompany work trains?

Supervision Is of First Importance

By J. B. Kelly
General Roadmaster, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.

The maintenance departments of the railroads are becoming trained to look at any problem from the aspect of cost and not, as was the case a few years ago, to view it with the idea of accomplishing something regardless of cost, letting the expense follow as a matter of course. In fact, most roadmasters when approached on any problem today will get into the matter of cost at once. This attitude leads to studies of organization and as regards this particular question, as well as so many others, good supervision is one great essential for getting work done properly and economically.

Any roadmaster can perfect working regulations for work train operation that will net his company the equivalent of his daily compensation, each day the train is in service, if he can follow up his plans by being in the field himself. When the train is assigned to uniform work this does not mean that he must be with the train daily but that he must be at hand whenever there are any complications or the work is of a variable nature. Under such circumstances results will not be obtained without thorough supervision. Therefore the solution is for the roadmaster, his assistant or a specially selected foreman to work diligently with the work trains in the field. One of them *must* stay with it.

It is not unusual for a roadmaster or a supervisor to have two or three work trains on his territory at the same time. As a typical example, one may be handling rail in a relay operation, one in ditching service and a third on ballast work. Without proper assistance he should divide his time among these work trains and necessarily put everything else aside. However, the call made on the roadmaster's time by his other responsibilities will not permit this and he should be given the assistance of the best foreman obtainable who is thoroughly experienced in work train operation. This foreman may be employed as a division man to be assigned wherever his services are needed. Otherwise the latent difficulties will not be met as they come to light and laxity in work train service is practically beyond the reach of figures.

Desirable in Most Cases

By J. J. Desmond
Roadmaster, Illinois Central, Chicago.

It is essential that foremen be carefully selected for work train service, especially in a large terminal where the handling of work trains brings about additional complications in train movements. A foreman who is regularly assigned to this work from the maintenance department is usually in a position to handle his work

more economically by making his plans ahead of time so as to perform his work with the least possible delay.

Considerable inconvenience is brought about by placing a different foreman on the work train each day as there is a possibility of securing an inexperienced man and by the time he gets acquainted with the work, the train crew and their methods of doing the work, some delays will be incurred.

At outlying points it is not always convenient to select the foreman for work-train service and it is found that the average foreman is in a better position to handle the work on his own section than a new man who is not familiar with what is required of the work train. However, on construction work I consider it advisable to select a foreman for work train service and have him regularly employed.

It is essential that supervisors make it a practice to accompany work trains since their presence usually results in work train moving more promptly, avoiding train delays, etc. More money can be wasted in one day by the improper handling of a work train than in almost any other way. Work trains should be given preference wherever possible as in most cases a large number of men are also being delayed when these trains are slowed up waiting for other trains to move.

A Competent Foreman Is Essential

By O. Suprenant
Roadmaster, Delaware & Hudson, Schenectady, N. Y.

If local conditions demand the service of a work train three or more days a week, it is absolutely necessary to appoint a permanent work train foreman. This man must be selected from among experienced men. He must be a good judge of material in general and have practical knowledge of track work in order to be able to meet any emergencies which he may encounter while performing his regular duties. The roadmaster and assistant roadmaster must keep him well posted in advance in order to enable him to eliminate any false moves, accompanying the work train occasionally to see that the work is performed economically.

The responsibility of a work train foreman is too much today to permit any chances to be taken with an ordinary foreman. If the amount of work on one sub-division does not demand a permanent work train foreman, one should be assigned to two sub-divisions. The amount of money that can be saved with a qualified work train foreman will be ample to keep a subdivision in good surface and line and perhaps also to tighten a few bolts.

Best Sizes of Compressor Plant

What size of compressor plant is most suitable for a railroad bridge erection crew handling both maintenance and the erection of all except the largest bridges?

A Compressor Displacing 160 Cu. Ft. of Free Air Per Minute Will Be Satisfactory

By Phillip George Lang, Jr.
Engineer of Bridges, Baltimore & Ohio, Baltimore, Md.

In the vast majority of cases, ordinary bridge erection involves comparatively small structures. In this connection, attention is called to the fact that, in all probability, for the territory east of the Mississippi and north of the Ohio and Potomac rivers, approximately 95 per cent of all railroad bridge spans are less than 120 ft. in length. A review of bridge erection, involving 131 structures, on which work was performed within the past five years, indicates an average of 2,550 rivets driven on each job.

Incident to such work, a derrick car, a locomotive crane or a wrecking crane is used, this equipment having steam boilers, which condition would seem to indicate that, for the purpose of furnishing the air, a compressor may be used in connection with equipment of the character mentioned. However, when air is supplied in this manner the equipment cannot readily be used in bridge erection. It, therefore, appears that the interests of economy and working speed are best served if a separate compressor plant is furnished as a part of the equipment.

In many cases, the equipment requires a side track for storage, and frequently in railroad maintenance siding facilities are also required for the storage of the camp cars used for housing the men. Consequently, it would seem that portable compressor equipment intended for use in railroad bridge work should be mounted on flanged wheels, of standard gage, so that it may readily be moved along the track. Such portable units may be obtained assembled complete, that is, with gasoline engine, compressor and storage tank, and are ready for use when unloaded.

Gasoline fuel is convenient to handle and readily obtainable in any quantity desired, whereas it is a matter of some difficulty to obtain the coal required for the operation of a steam compressor, unless it is purchased in carload lots. Modern gasoline-driven compressors are satisfactory, especially when provided with proper and up-to-date ignition systems and other accessories.

A compressor displacing 160 cu. ft. of free air per minute will take care of all requirements in connection with ordinary railroad bridge erection in a satisfactory manner. Such a compressor, in conjunction with an air storage tank mounted on the same frame, is capable of supplying from two to three riveting gangs adequately. If, however, the air storage tank is placed on an air line, it is possible to supply four to five riveting gangs. While it is felt that compressor units of the character mentioned will meet the maximum needs on work of this character, it is recommended that the use of compressors smaller than that described be avoided.

Use a Portable Plant

By F. H. Cramer
Assistant Bridge Engineer, Chicago, Burlington & Quincy, Chicago.

In the past on many of the railroads, the horizontal type air compressor, driven either by a steam or gasoline engine, was installed in a box car and used to supply air for work on the larger bridges. The cost in laying long pipe lines and the delay and expense of setting and removing the car made this equipment of doubtful economy on short jobs. Since the development of portable air compressors the use of compressed air has been the most important advance in railroad construction practice in recent years. A portable machine that is correctly designed and properly built not only makes a very desirable machine for producing air power, but also one which can easily be loaded and shipped from place to place and used anywhere.

The type of compressor plant most suitable for a bridge crew handling the erection and maintenance of bridges depends largely upon the class of work to be done. For a crew that is assigned to light mainte-

nance work, building wooden pile trestles, erecting light or short steel plate girder and I-beam spans and highway bridges and cleaning and painting steel bridges, a machine with a capacity of 120 cu. ft. of free air per minute is most suitable.

On larger construction work, such as the erection of steel truss spans, deck and through plate girder spans; cement gun work; the building of cofferdams using sheet pile hammers, one or more rock drills, pneumatic hammers, drills and reamers; the removing of scale and rust with the sand blast, etc., a machine having 180 cu. ft. capacity, or larger, is desirable to carry out the work economically.

On our system we have a number of these portable machines and the amount of work is sufficient to keep them busy winter and summer. We also find that they can be used for other purposes than bridge work. In connection with a serious washout and change of line recently in our western territory one of these portable air machines was used continually for a year in a rock pit where many thousand yards of small and large rip rap were hauled out and placed to protect embankment and slopes on bridges. One was also used to grout a large number of holes sunk 30 to 60 ft. in the ground to stop leakage at one of our reservoirs which is located some distance from the railroad. They are used frequently at roundhouses or shops to substitute for or assist the regular compressor when in poor condition or undergoing repairs.

Each machine should be equipped with one or two air riveting hammers, an air motor, a chipping hammer, stone drill machines, a paint spray, etc. With these tools this machine can be used on practically all types of bridge construction work.

Power Wheels in Front or Rear

Should a motor car be run with the power wheels in the front or in the rear? Why?

Power Wheels Should Be in Rear

By J. R. Watt
General Roadmaster, Louisville & Nashville, Louisville, Ky.

In my opinion, a motor car should be designed to operate with the power wheels in the rear.

Both wheels on the driving axle are tight. The loose wheel, therefore, must be at the opposite end of the car. The natural and advantageous place for a loose wheel is at the front end. The men dismount more naturally and safely at or towards the rear end and lift the back end of the car to remove it from the track or turn it around. It requires more time and is a more unnatural and unsafe method to go to the front end to lift the car. Then, the placing of the motor in the front end makes the car safer in operation.

Furthermore, many roads use high safety railings at the front end of the car, which not only prevent the men from unloading readily at that end but also interfere with the convenient lifting of the front end of the car. The natural convenience and shorter time interval in getting to the rear end for lifting, together with the absence of interference with large safety railings and screens are items of practicability and satisfaction worthy of consideration, to say nothing of the greater safety.

Obviously, when there are two tight wheels on an axle there must be some slipping and twisting in going around a curve, because the two wheels must revolve at the same speed although one is traveling the shorter path. They do not roll as smoothly and perfectly as when there is one loose wheel on the axle. There is no doubt but that it is preferable to have the leading wheels run naturally and true, and confine any slipping and twisting to the trailing wheels.

In short, the cars are more easily handled and operate more smoothly and safely by having the power wheels in the rear.

Put the Loose Wheels in the Rear

By E. S. McKernan
Supervisor of Tools, Atchison, Topeka & Santa Fe, Topeka, Kan.

We find it advisable to run a loose wheel in the rear, for the following reasons:

First, should a derailment result from the loose wheel coming off the axle it would throw the men to the rear of the car instead of in front of it, with much less danger of a serious accident. Furthermore, it has been found safer to lead the loose wheel than to have it in front and drive it.

Second, a loose wheel, being in the rear, is generally on the heavy end of the car, consequently the light end is always lifted in removing the car to and from the track, which is of very much advantage.

A Weed Killing Problem

When using chemicals to kill weeds at what period of their growth should the application be made?

Make Several Applications

By Jesse S. Hyatt
General Manager, Chicago, North Shore & Milwaukee, Highwood, Ill.

It has been our practice to make one application of the weed killer as early as possible, in order to get the young growth of weeds. After we think the spring rains have passed and the new growth of weeds is fairly well along, we go out the second time. We try to pick hot sultry days for this, as it seems the chemicals take better hold of the vegetation in this kind of weather. A third application is made late in August or early in September.

We have found that three applications a year takes care of our condition very well, as each application takes care of the weeds which sprout after the previous application.

The Growth Should Be Well Started

By Observer

The problem of killing weeds requires variations in the method in different climates and in different weed growths. Some differences of opinion also exist as to the best plan of action and also as to just how the chemicals act in killing the weed growth. There is, however, substantial justification for the opinion that the chemical acts most effectively by being brought in contact with the leaves and stems of the plant above the ground, or what is known as the "surface presentation." In other words, the opinion is that the effect of the poison on the plant is more thorough if it is applied to the growth above the ground whence it is transmitted from the leaves through the branches and main stems to the roots rather than by applying the chemical to the bare ground with the view to providing a sufficient saturation of the ground with the

poison to cause serious injury to the roots that are buried in it.

On this basis, therefore, the chemical will be most effective if the growth has had a fair start and presents a more or less complete covering over the ballast and roadway shoulders so that practically all of the chemical which is sprayed on the roadway will fall on weed growth and be effectively absorbed by the tissues of the plants. Whether or not any further application of the chemical is necessary depends upon the degree with which the plants are able to recover from the effects of the poison during the course of the season.

Foundations for Brick Floors

Is it good practice to lay a brick floor in a roundhouse without a concrete base?

It Is Not Good Practice

By A. L. Sparks
Architect, Missouri-Kansas-Texas, St. Louis, Mo.

There are some conditions under which a brick floor with loose joints may give good service without a concrete base but this is not good general practice. Roundhouse floors should be so constructed as to provide good drainage, for in washing, testing and filling boilers some water is wasted onto the floor; frequently, valves on the cold water lines are not entirely closed and the water running down into the brick joints softens the fill under the floor, resulting in settlement at such points. These low pockets make a sump for the accumulation of dirt and water and are a nuisance as well as being hard to truck and work over. Wheels are sometimes rolled on the floor and unless the bricks have a solid base they are easily broken. Where low places and broken brick occur, the bricks are easily knocked out, dislocating the adjoining ones and creating a stumbling block for the men to trip over.

Where a roundhouse is located over a course sand or gravel bed, a brick floor laid over a thoroughly compacted base may drain sufficiently through the bed as not to cause objectionable uneven settlement, but such conditions are seldom found.

Experience Demonstrates Objections

By L. P. Kimball
Engineer of Buildings, Baltimore & Ohio, Baltimore, Md.

It is not our practice to lay brick or any other material as a wearing surface without the use of a concrete base as we have found from experience that heavy service in these buildings soon damages a paving surface unless it is properly supported.

Keeping Frost Boxes Open in Summer

Should the frost of water tanks and water columns be left open during warm weather?

They Should Be Left Open

By E. M. Grime
Supervisor of Bridges and Buildings, Northern Pacific, Jamestown, N. Dak.

Aside from fire, the fungus-growth decay known as dry rot is probably the most serious enemy of most timber structures. The mycelium or membranous growth of this fungus thrives where there is a moist condition and warm stagnant air and the wooden frost chamber of a water tank, during the summer season, provides an ideal situation for such decay if no ventilation is provided. It is therefore desirable to leave the door of the water tank frost chamber open during the time when there is no danger of freezing in order to permit as much circulation of air as possible. Where water column pits have a double or triple deck for frost protection, it is a good plan during the summer to lay aside the lower manhole covers so that the air may circulate to some extent between the decks and tend to keep them dry.

Keep Them Shut

By F. M. Case
Water Service Foreman, Chicago & North Western, Belle Plaine, Iowa.

I do not believe that the leaving open of frost boxes of water tanks and water columns during warm weather would be good universal practice. Valves are frequently located inside; if doors are left open, there is a hazard that valves may be operated by irresponsible persons.

Frost box doors are usually made in series; that is, several separate or consecutive doors for one opening; if left open during the summer some of the doors are liable to be missing when required to close the frost box for the winter.

It is the writer's experience that frost boxes do not deteriorate rapidly from lack of ventilation.

Cleaning Out Inverted Siphons

How should an inverted siphon culvert be constructed to facilitate the removal of sediment or other debris?

Provide Vertical Shafts at Each End

By Engineer of Design.

Inverted siphons are not often required under railway tracks, ordinarily, they are installed to carry an irrigation ditch under a railway track in a cut, or to carry cross-drainage under a railway track in a side hill cut where the water cannot be accommodated in the side ditch. The siphon is almost certain to prove troublesome under any circumstance, but it is particularly objectionable where it carries natural drainage subject to rapid flow. Owing to the fact that an inverted siphon flows full of water no matter how small the discharge, the velocity of the water through it becomes extremely small as the discharge falls off, with the result that any sediment or suspended matter in the water is bound to be deposited within the limits of the siphon. For these reasons resort should be had to the inverted siphon only in cases where no feasible means are at hand to avoid it.

To make an inverted siphon as nearly self-cleaning as possible it should be designed to give the most rapid flow possible. In other words, the cross section should be made as small as conditions will permit. Of course, a retricted cross section means that a higher velocity head must be developed to obtain the desired discharge and this in turn means that the water must be backed up at the upstream end. This is possible only under certain conditions and is usually entirely out of the question in the case of irrigation ditches.

In general, therefore, the construction of an inverted siphon means that adequate provision must be

made for periodic cleaning out of the sediment. To meet this requirement the usual plan is to build the risers at each end of the culvert in the form of vertical shafts to permit the mud to be hoisted or shoveled out with the least difficulty. Plans also often provide for having the floor of the shaft a foot or more lower than the bottom of the culvert barrel to form a pocket to act as a catch basin. This will aid in some measure in keeping the floor of the barrel free of sediment.

Labor and Material Costs in Welding

What would be the ratio between the labor cost and the charges for gas and metal in building up frogs and track joints by the oxyacetylene process?

No Fixed Ratio Obtains in All Cases

By L. C. Ryan
The Oxweld Railroad Service Company, Chicago.

A number of highly variable factors will affect not only the relation between the cost of labor and of gas and material but also the total cost of the job. Initially, attention should be called to the fact that the rate paid to track welders by the several railroads varies rather widely. On some roads the practice is to pay the track welders a rate a few cents higher than that of laborers in the maintenance department, while on other roads the torch operators are paid a rate nearly or quite equal to that of welders in the mechanical department. This variation in labor rates alone would make it impossible to set any definite ratio.

It is also evident that the relation between labor and material cost will vary with the conditions under which the work is performed. If the welder is building up frogs, crossings or switch points out of track, the labor cost will obviously be proportionately lower than when the same work is being performed under traffic, as in the former case the torch may be operated continuously, while in the latter there must be numerous delays of greater or less duration on account of the passing of trains. Further, a certain amount of time will be lost getting to and from the job and in changing from one location to another. In the welding of rail ends under traffic the frequency of trains will affect the labor cost per joint. It is further evident that if the joints are being built up out of face the labor cost per joint will be lower than when only part of the joints are being repaired and the welder is required to make long and frequent moves with his apparatus.

Another factor which will materially affect the labor cost is the method of gang organization employed. In all welding under traffic it is necessary to employ helpers to move the equipment ahead as the work progresses and to watch for approaching trains. The most efficient method of organization when welding rail joints is to employ four or more welders in the gang which makes it possible to handle the work with not more than half the number of helpers which would be required if the welders were working single. It is apparent that when this form of track welding organization is used the ratio of labor to other costs will be considerably lower than when a single welder and helper are used.

On one of our large railroads, which has been welding a large number of joints each year for several years, the present labor cost amounts to 48 per cent of the total as against 52 per cent for gas and filling metal. These figures may be taken as fairly representative of the ratio for joint welding where the work has been well developed and where the joints are kept up by applying metal as soon as the rails begin to show serious battering. It may be of interest here to state that the greatest economy from the welding of battered rail ends, frogs, crossings or switch points results when the work is done at such time as the parts begin to show sufficient wear to cause slight unevenness in the track and before the damage has developed to the point where angle bars and bolts are worn or seriously loosened. When the work is done at such a time the original cost is at a minimum and the track is always maintained in first-class condition.

This suggestion as to the economy of building up rail ends and frogs before the wear has become serious points to another factor which will affect the relation between the cost of labor and material. If the parts are built up while the wear is slight the labor cost will obviously be higher in relation to that of gas and filling material than when excessive wear makes it necessary to apply a large amount of filling material. It is evident however that while the labor cost is relatively higher where the filling is light the total cost of the job is very much less.

It is obvious that the economy resulting from track welding depends more upon the quality of the work than upon its cost. Joints and frogs built up by competent operators, using a suitable filling metal and approved methods, will increase the life of the material by not less than 75 per cent. In order that this result may be secured however it is absolutely essential that the torch operators be carefully instructed and competently supervised and that they be supplied with welding equipment of a high standard and with a filling metal which will withstand the wear as well as or better than the original metal of the rail.

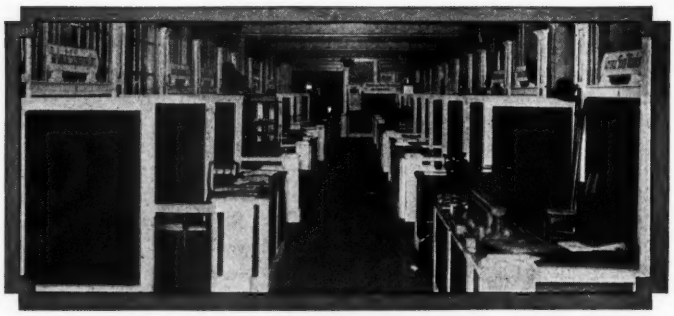
Approximately Forty-Sixty

By Julius H. Goos
Inspecting Engineer, Great Northern, St. Paul, Minn.

For general estimating purposes, the labor should aggregate about 40 per cent and the charges for gas and metal about 60 per cent of the total cost. This will naturally vary somewhat, depending upon the class of work, delays, location, efficiency of the workmen, etc.

My conclusions are based upon the fact that we had 30 operators on frog welding on the various divisions of the system during the month of May who reclaimed 250 frogs in track under traffic at an average cost of $15.30 each, placing an average of 54 oz. of metal on each frog. The labor charge during this month was 42 per cent, the gases (oxygen and acetylene) 51 per cent and steel rods 7 per cent. We also had 48 torch operators on battered joint welding on various divisions during the same month who built up 7,999 battered joints at an average cost of $1.81, placing an average of 5.7 oz. of metal on each joint. The labor charge for this group during this month was 38 per cent, the gases 55 per cent and steel rods 7 per cent. These are reliable figures taken from a large number of observations by efficient workmen under varying conditions. Many of these welders have been in our service since the process was adopted in this department some five years ago.

New and Improved Devices



An Improved Centrifugal Pump

THE LATEST model of the Layne vertical centrifugal pump, for lifting water from deep wells, is shown in the accompanying cut. Many improvements and a number of refinements have been incorporated to increase its efficiency, durability and smoothness of operation. Only one stuffing box is used in the entire assembly, namely in the pump head at the ground level. The box has a perfectly plain design. The motor is direct connected through a flexible coupling, balanced dynamically and statically. The hydraulic down thrust, as well as the weight of the shaft and impellers is carried by a thrust bearing of the tilting segment type, immersed in oil. The

The New Layne Vertical Centrifugal Pump

radial bearing of the full floating shaft is mounted in the same housing and automatic lubrication is effected by centrifugal force acting on the oil in the rotating bearing. This automatic oil circulation can be seen through a sight feed gage. Additional bearing protection is afforded by forced water circulation through a coil of copper tubing inside the bearing housing.

The shaft is full floating and is supported only at the drive point, eliminating all side strain. It is entirely enclosed in a steel tube casing filled with oil. Water rising through the discharge column surrounding the shaft casing does not come in contact with the oil and its flow is not obstructed by exposed bearings and their supports. The bottom guide bearing is enclosed so that no sand can reach the drive shaft and its housing has a stream line form which offers minimum resistance to flow of water through the pump.

The bowls allow greater step-up in each stage than heretofore. All impeller and diffuser castings are made from machined metal patterns, core boxes and dryer plates to obtain a correct spacing of vanes and ports. The result is the same back pressure of discharging water at all points around the impeller, producing a true hydraulic balance. Each impeller is also in dynamic and static balance. All passages in vanes and diffusers are hand finished. The impellers are of the closed type with a solid plate above and below the blades, giving adequate strength and preventing the leakage of water between moving blades and stationary bowls. These pumps are manufactured by the Layne & Bowler Company, Memphis, Tenn.

A New Design of Track Shovel

ONE OF THE recent additions to the various types of track tools which are in use on the railways today is a new No. 2 track shovel which is being manufactured by the Verona Tool Works, Pittsburgh, Pa. This shovel incorporates a number of features of design and construction that are of considerable interest. The blade of the new shovel is of high carbon steel with the straps of low carbon, both blade and straps being of the same gage steel. The blade is heat

The Complete Shovel, the Blade and the Handle

treated and tempered for about 1½ in. back from the edge in order to resist wear, the remainder of the blade being annealed to secure toughness and resistance to breaking. The front strap is quite large and forms a socket for the handle within the area of the blade that is approximately 4 in. deep, and both straps are of such a design that they encase the full size of the handle for approximately 3 in. above the blade before they are spread to reach up and around the front and back of the handle. The straps are welded to the blade, the weld being ⅞ in. wide around the entire strap with a maximum of 1⅛ in. at the point of the strap. The junction of the top edge of the blade and the socket formed by the straps is tightly closed by the welding in order to exclude water or other matter from the socket.

The handle or stem is of double-X northern ash, selected to give a breaking strain of over 300 lb. and is driven into the socket which is of the tapered type, so as to fill it entirely to the base of the weld. It is held by three rivets. An IDL handle is used and this has permitted the turning of the stem so that the grain of the wood is with the bend and is in the position to give the maximum resistance to strain. The handle is fastened to the stem by two rivets, the ferrule around the stem being in two parts with a small space between, to give a take-up in case of shrinkage or wear. The grip is of close grained birch and of ample size. It is prevented from turning by tenons on the ends and is also made so that it can be tightened when desired. The drop or the distance from the grip to the ground when the shovel blade is in the level or working position is 19 in. The weight is between 5½ lb. and 6 lb. depending on whether the blade is No. 12 or No. 13 gage in accordance with the specifications for eastern and western roads.

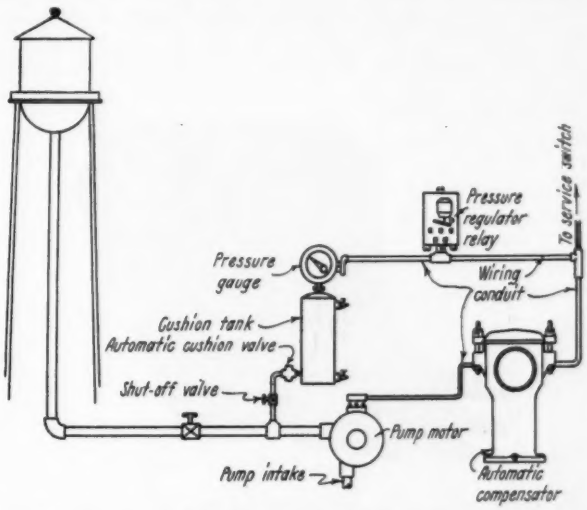
Automatic Control for Pumping Plant

AN ILLUSTRATION of the part played by automatic control equipment in reducing the attendance expense in pumping plant operation is afforded by the changes made in the water station of the Grand Trunk at Flushing, Mich. This was formerly a steam plant which pumped water from the Flint river into a roadside tank, an attendant being required to fire the boilers and stop and start the pumps. A float indicator showed the amount of water in the tank.

To eliminate the need of an attendant this plant was remodeled to make it entirely automatic in operation and introduce the necessary safeguards to insure thorough reliability of service. The old steam pump was replaced by a centrifugal pump operated by a 10-h.p. induction motor. The motor is started and stopped by a pressure regulator which starts the motor at 26.5 lb. pressure and stops it at 29 lb. The regulator operates in conjunction with a pressure gage on the pump discharge line and is therefore subject to the surges of pressure or water hammer that attends the operation of the pump. It was therefore impossible to connect the regulator directly into the discharge line because the sudden changes of pressure would cause the regulator to stop and start the pump with each jump in pressure. Instead a cushion tank was introduced between the discharge line and the regulator as shown on the drawing, the contained air affording an effective cushion to ease off both the abnormally low and abnormally high pressures, and has made it possible to use the pressure control within close limits without any trouble.

The induction motor is started automatically (with the closing of the switch in the regulator) through the aid of an automatic compensator which supplies current to the motor at a lower starting voltage from a transformer until the speed picks up and reduces the current to normal, when the motor is automatically connected direct to the power line.

A further safeguard on the plant is a second pressure regulator set to upper and lower limits of 30 lb. and 25 lb. respectively which is arranged to light red signal lamps in the station agent's office at Flushing whenever the pressure reaches either of these limits.



Arrangement of Equipment for Automatic Control

This signal indicates that the pressure has passed beyond the limits set for the control of the pump and thus show that something is wrong, as for example, the clogging of the pipe line. The agent and operators are instructed to notify the water service department at once whenever this signal is given.

Another unique feature of this plant is provision for heating the pump house by an electric heater which is controlled by the thermostats. All of the control apparatus for regulating the pumping was supplied by the Electric Controller & Manufacturing Co., Cleveland, Ohio.

A Rugged Front Construction For a Steam Shovel Dipper

A NEW DESIGN of dipper front has been placed on the market which embodies certain features that are of definite interest to railway officers concerned with steam shovel operation. As seen in the

The Arrangement of the Teeth in the Pocket May Be Varied

illustration, this front has a bottom provided with double walls connected by a series of ribs spaced equal distances apart so as to form pockets for inserting the teeth. The arrangement is such that the teeth are

readily inserted or removed, no bolts or other locking devices being necessary. This makes it possible for the operator to arrange the teeth in any order which he deems necessary for the character of digging imposed by the particular job. For example, the front for a 2½-yd. dipper has nine pockets and the operator may use either three, four, five or nine teeth, depending on the kind of material to be dug. The normal arrangement is to provide digging teeth made of square tool steel bars in alternate pockets and to insert pick-up teeth made of manganese steel in the pockets between.

After the teeth have become worn small blocks may be inserted in the bottoms of the pockets, thereby pushing the teeth forward by the corresponding

An Under View of the Dipper Front Showing the Flat Face Presented Against the Pit

amounts. This makes it possible to keep the projection of the teeth uniform in spite of uneven wear and insures an even distribution of the pressure on all the teeth.

Another advantage of this dipper front to which the manufacturers call attention is the fact that its underside is perfectly flat, thus insuring a smooth, even cut which is of marked assistance in obtaining uniform side slopes in railroad cuts. The front is made entirely of manganese steel, thereby affording high resistance to breakage and wear. This dipper front is manufactured by the American Manganese Steel Company, Chicago Heights, Ill.

Result of a Coyote Shot

With the Associations

The Bridge and Building Association

The Statler Hotel has been selected as headquarters for the thirty-fifth annual convention which will be held at Buffalo, N. Y., October 20-22.

A meeting of those members of the executive committee who reside in the vicinity of Chicago will be held in that city on Friday, July 31, to formulate plans for the convention.

The Roadmasters' Association

The tentative program for the forty-third annual convention which will be held in the municipal auditorium at Kansas City, Mo., on September 22-24 is as follows:

TUESDAY

10:00 a. m.—Convention called to order.
10:10 a. m.—Opening address: C. E. Johnston, vice-president and general manager, Kansas City Southern, Kansas City, Mo.
10:30 a. m.—President's address: W. F. Muff, roadmaster, Atchison, Topeka & Santa Fe, Newton, Kan.
10:45 a. m.—Address by R. H. Aishton, president, American Railway Association.
11:15 a. m.—Appointment of special committees
11:20 a. m.—Report of Committee on the Programming of Section Work.
2:00 p. m.—Paper by A. N. Reece, chief engineer, Kansas City Southern, Kansas City, Mo., on "The Treatment of Soft Roadbed."
2:45 p. m.—Report of Committee on Means of Prolonging the Life of Rail.
3:30 p. m.—Address by Colonel F. W. Green, vice-president, St. Louis Southwestern, St. Louis, Mo.
8:00 p m.—Address by Colonel F. G. Jonah, chief engineer, St. Louis-San Francisco, on "The History of Railroading."

WEDNESDAY

9:30 a. m.—Report of Committee on How to Inspect and Identify Ties for Renewal.
11:30 a. m.—Address by L. W. Baldwin, president, Missouri Pacific, St. Louis, Mo.
2:00 p. m.—Address by N. M. Rice, vice-president, New York, New Haven & Hartford.
2:45 p. m.—Report of Committee on The Roadmaster's Responsibility for Proper Relations with the Public.
6:30 p. m.—Annual dinner given by the Track Supply Association.

THURSDAY

9:30 a. m.—Report of Committee on The Weeding of Tracks—Methods and Cost.
10:30 a. m.—Business session.
1:30 p. m.—Inspection of Kansas City Terminals by special train.

The Track Supply Association

All but four of the spaces available for the exhibit of the Track Supply Association, which will be held in the Kansas City, Mo., municipal auditorium immediately adjacent to the convention meeting room, have been taken, a total of 46 firms having already taken membership. Those firms which have reserved space

since the appearance of the July issue of *Railway Engineering and Maintenance* are as follows:

The Hackmann Railway Supply Company, Chicago.
The Cleveland Railway Supply Company, Cleveland, O.
The Reade Manufacturing Company, Hoboken, N. J.
The Chausse Oil Burner Company, Elkhart, Ind.
The Northwestern Motor Company, Eau Claire, Wis.
The Grip Nut Company, Chicago.
James C. Barr, Boston, Mass.
The Koppel Industrial Car and Equipment Company, Koppel, Pa.
The Differential Steel Car Company, Findlay, O.

The Wood Preservers' Association

Forty-two members of the American Wood Preservers' Association and of the Committee on Wood Preservation of the American Railway Engineering Association met at the Hotel Windsor, Montreal, Que., on July 8 and 9. The first day was spent in a consideration of the work of these organizations. In the evening a dinner was given, following which papers were presented by A. R. Joyce of the Joyce-Watkins Company, Chicago; R. S. Belcher, manager of treating plants of the Atchison, Topeka & Santa Fe, Topeka, Kan., and L. C. Draefahl, of the Grasselli Chemical Company, Cleveland, Ohio. A portion of the following day was spent in an inspection of the Canadian Forest Products laboratory at Montreal.

The annual proceedings of the association containing the report of the annual convention which was held in Chicago last February are now on the press and it is expected that they will be completed and mailed this month.

Directory of Associations

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—C. A. Lichty, secretary, 319 North Waller avenue, Chicago. Next convention, Buffalo, N. Y., October 20-22, 1925.

AMERICAN RAILWAY ENGINEERING ASSOCIATION (Works in co-operation with the American Railway Association, Division IV).—E. H. Fritch, secretary, 431 South Dearborn street, Chicago. Next convention, Congress Hotel, Chicago, March 9-11, 1926.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—E. J. Stocking, secretary, 111 West Washington street, Chicago. Next convention January, 1926, Cleveland, Ohio.

BRIDGE AND BUILDING SUPPLY MEN'S ASSOCIATION.—B. J. Wilson, Pocket List of Railroad Officials, 605 Fischer Building, Chicago. Annual exhibit at convention of American Railway Bridge and Building Association.

NATIONAL ASSOCIATION OF RAILROAD TIE PRODUCERS.—J. S. Penney, secretary, T. J. Moss Tie Company, St. Louis, Mo. Next convention January, 1926, Cleveland, Ohio.

NATIONAL RAILWAY APPLIANCES ASSOCIATION.—C. W. Kelly, secretary, Seeberger Building, 825 South Wabash avenue, Chicago. Annual exhibition at convention of American Railway Engineering Association.

ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION.—T. F. Donahoe, secretary, 428 Mansion street, Pittsburgh, Pa. Next convention September 22-24, 1925, Kansas City, Mo.

TRACK SUPPLY ASSOCIATION.—W. C. Kidd, Ramapo-Ajax Corporation, Hillburn, N. Y. Annual Exhibit at convention of Roadmasters' and Maintenance of Way Association.

RAILROAD MOVIES—The Chicago, Burlington & Quincy is now using the amateur motion picture camera as means of instruction for employes. This company purchased one of the amateur cameras to aid in freight claim prevention work but after realizing the ease with which it could be adapted to other conditions has since used it for other purposes.

Among the pictures produced by the Burlington, one on car seals, shows the proper way to seal a car. Another on the icing of refrigerator cars gives instruction in the proper way to ice.

The Material Market

THE MARKET for iron and steel products is at present in a more indeterminate state than it has been for a considerable number of weeks. Whereas conditions a month ago were definitely depressing, as evidenced by decreased orders, curtailment of production and a lowering of prices, the condition at present is decidedly mixed. Thus the fact that the railroads have ordered only a relatively small number of cars is still seriously felt in the demand for steel plates. On the other hand, as indicated by the equipment and supply section of our news columns, the railroads are now definitely entering the market for rail and track fastenings. There is also an increasing demand for structural steel for buildings. As shown by the table below the prices have been subjected to relatively few changes during the past month.

PRICES PER 100 LB.

	June				July			
	Pittsburgh		Chicago		Pittsburgh		Chicago	
Track spikes	$2.80	$3.10	$2.90	$3.00	$2.80	$3.10	$2.90	$3.00
Track bolts	3.90	4.25	3.90	4.00	3.90	4.25	3.90	4.00
Angle bars	2.75		2.75		2.75		2.75	
Tie plates, steel	2.35	2.40	2.35		2.35	2.40		2.35
Boat spikes	3.25		3.25		3.25		3.25	
Plain wire	2.45		2.50		2.50		2.55	2.60
Wire nails	2.65		2.75		2.65		2.70	2.75
Barb wire, galv.	3.40		3.50				3.40	3.45
C. I. pipe, 6 in. to 12 in., ton			47.70					48.20
Plates	1.90	2.14	2.20		1.90			2.10
Shapes	2.00		2.20		2.00		2.00	2.10
Bars, soft steel	2.00		2.10		2.00			2.10
Rivets, struct.	2.40	2.50	2.65		2.40	2.50		2.60
Conc. bars, billet	2.00					2.00		
Conc. bars, rail			2.00					2.00
Rail, per gross ton, f. o. b. mills			43.00					43.00

The scrap market continues to show strength, the prices in the table below for the past month being the same or moderately higher than those for the month previous.

PRICES PER GROSS TON AT CHICAGO

	June	July
Relaying rails	$25.00 to $26.50	$26.00 to $31.00
Rails for rerolling	17.50 to 18.00	17.50 to 18.00
Rails less than 3 ft. long	18.00 to 18.50	18.25 to 18.75
Frogs and switches cut apart	16 25 to 16.75	17.00 to 17.25
Steel angle bars	17.50 to 18.00	17.50 to 18.00

Probably the best measure of conditions in the lumber market is to be had from the fact that the lumber manufacturers are making a concerted effort to decrease production, some of them urging a shut-down of all production for a period of not less than 30 days. The justification offered for this policy is that prices of lumber have depressed to a point such that they afford a return that is less than the cost of production. The tables of lumber prices below indicate no appreciable changes from those quoted last month.

SOUTHERN PINE MILL PRICES

	June	July
Flooring, 1x4, B and B flat	$44.83	$45.74
Boards, 1x8, No. 1	36.45	36.90
Dimension, 2x4, 16, No. 1, common	26.33	27.04
Dimension, 2x10, 16, No. 1, common	29.05	28.25
Timbers, 4x4 to 8x8, No. 1	28.65	27.31
Timbers, 3x12 to 12x12, rough	37.85	

DOUGLAS FIR MILL PRICES

	June	July
Flooring, 1x4, No. 2, clear flat		$27.00
Boards, 1x8, 6 to 20, No. 1, common	$16.50	16.50
Dimension, 2x4, 16, No. 1, common	17.50	17.50
Dimension, 2x10, 16, No. 1, common	17.00	17.00
Timbers, 6x6 to 8x8, No. 1, common	23.00	23.00
Timbers, 10x10 to 12x12, rough	18.00	18.00

The prices of Portland cement remain practically stationary, the quotations for the cities below showing no change from those given in last month's issue.

New York	$2.15	Minneapolis	$2.42
Pittsburgh	2.19	Dallas	2.05
New Orleans	2.40	Denver	2.84
Chicago	2.20	San Francisco	2.31
Cincinnati	2.47	Montreal	1.80

News of the Month

The Michigan Central has decided to replace local freight train service between Niles, Mich., and Ann Arbor, by motor trucks. If this proves successful the truck service will be extended over other parts of the line.

The Chicago & Northwestern has applied to the Interstate Commerce Commission for permission to abandon 16 miles of narrow-gage line between Fennimore, Wis., and Woodman. In 1923 the cost of operating this line was more than five times the total receipts.

The railroad stop law, which is being put into effect in Louisiana, requires drivers of all motor vehicles to come to a complete stop at a distance of not less than 10 ft. or more than 50 ft. from a railroad track and carries a penalty of $50 fine and imprisonment for 30 days for violation. The law does not apply in municipalities with a population of 10,000 or more inhabitants.

Employees of the National Railways of Mexico, who have been outspokenly dissatisfied with the government's economy measures in the operation of the railways, have been warned by President Calles that in the event of a strike the strikers will be vigorously prosecuted and any violence suppressed by the army. The government in its efforts to make the railways pay their way has reduced the forces in some instances as much as 50 per cent and has effected similar reductions in the wages of the employees retained.

On July 14 a tablet in memory of the late Alfred H. Smith, president of the New York Central, was unveiled on the Alfred H. Smith Memorial Bridge over the Hudson river at Castleton, N. Y. The building of the bridge and the Castleton cut-off were begun by President Smith and the bridge was named in memory of him. President P. E. Crowley, of the New York Central, opened the unveiling ceremonies. He was followed by C. C. Paulding, assistant vice-president, and the Rev. Dr. F. N. Clendenin. Miss Charlotte Smith, granddaughter of President Smith, unveiled the tablet.

Net earnings of the Canadian Pacific for the five-month period ended with May show a decrease of nearly $1,750,000, as compared with the same period of 1924. Gross earnings are lower by $7,750,000, while operating expenses decreased slightly over $6,000,000. The aggregate gross earnings of the Canadian National for the five months of this year show a decline of $7,845,410, or 8.2 per cent, as compared with the same period last year. Operating expenses in that time were reduced by $8,484,319 or 9.2 per cent, and net earnings were $4,174,722, an increase of $618,909 or 17.4 per cent, over the first five months of 1924.

The Great Northern has applied to the Minnesota Railroad & Warehouse Commission for permission to establish motor bus routes through various parts of the state. It is proposed that the motor bus service will be handled through the Great Northern Transit and the Minnesota Transportation companies, subsidiaries of the railroad. The plan calls for 13 lines requiring 40 busses to be operated over 1,300 miles of highway in the territory of the Great Northern and provides for interchange of traffic with existing bus lines and a system of interchangeable tickets for passage over combination bus and rail routes.

Badges have been issued by the Detroit, Toledo & Ironton to all employees of that railroad. The purpose of these badges is to permit officers and employees of the railroad to identify each other as persons duly authorized to be on the property and to afford a ready means of keeping trespassers off the right of way. Every employee must wear his badge at all times when on duty. The badges have been assigned the value of $5 each and any employee who loses his badge will have that amount deducted from his wages. The station agents have been officially authorized to deliver and take up employees' badges, the agents being expected to take up a badge before delivering pay checks to employees who are leaving the service.

The revenue freight car loadings for the week ending July 11 totaled 982,809 cars, representing an increase of 72,826 cars compared with the corresponding period of last year but a decrease of 37,000 cars compared with 1923. However, the cumulative total car loadings for the first 28 weeks of 1925 are appreciably larger than the total for the same period of 1924 and 1923, the figures being 26,144,889 cars for 1925, 24,853,039 cars for 1924, and 25,875,393 cars for 1923.

Frank Rhea, who has been serving for a number of years as a representative of the United States Department of Commerce in the Orient, has left that service and returned to the United States. Mr. Rhea has been acting American commercial attache for Japan, with headquarters at Tokyo, since December, 1924, and prior to that time served as registrar of American companies organized under the Chinese Trade Act, with headquarters at Shanghai. Mr. Rhea's headquarters will be at the Cosmos Club, Washington, D. C.

The Association of Maintenance of Way Foremen of the Cleveland, Cincinnati, Chicago & St. Louis will hold its third annual convention at St. Louis on August 28 adjourning 29. In addition to considering reports of committees and routine business, addresses will be presented by C. A. Paquette, president of the White Construction Company and formerly chief engineer of the Big Four, Hadley Baldwin, chief engineer C. E. Hill, general safety agent of the New York Central Lines and E. T. Howson, editor of *Railway Engineering and Maintenance.*

The Erie, which delivers l. c. l. freight in New York either at store-door or at inland freight stations, handling the freight from its cars on team tracks at Jersey City by motor truck, is planning to extend this service with the opening of the new Holland vehicular tunnels under the Hudson river. It will abandon its Monmouth street yard, Jersey City, as a storage yard for coaches and will remodel it into a team track yard. A new coach yard is under construction at Weehawken, N. J., about a mile further north. The Monmouth street yard is located in the immediate vicinity of the New Jersey entrance to the new vehicular tunnels.

The New Chicago Union Station was formally opened to the public and dedicated to service on July 23 when Samuel Rea, president of the Pennsylvania, officially tendered the new facilities to Mayor William E. Dever as the official representative of the people of Chicago. This presentation took the form of an address presented at a luncheon held in one of the dining rooms of the station at which the mayor and other officers of the city were the guests of the railroads owning the station. In addition to Mr. Rea the railroads were represented by Hale Holden, president of the Chicago, Burlington & Quincy, H. E. Byram, receiver of the Chicago, Milwaukee & St. Paul, and J. D'Esposito, chief engineer in charge of the construction of the terminal. The luncheon followed an official tour of inspection of the station.

Labor News

Maintenance Men Ask for Increase

Submissions on behalf of the maintenance of way employees of a number of railways have been filed with the Railroad Labor Board asking a general wage increase for all maintenance of way employees of five cents an hour. Among the roads involved are some of the largest in the country. As similar submissions are still coming in from other roads it is apparent that a campaign for wage increases for maintenance of way employees throughout the country is under way. After all the submissions have been received the Labor Board will set a date for the hearing which will probably be in the latter part of August or the first of Steptember after the summer vacations of the board members are ended.

Quarry Workers Come Under Agreement

The Nashville, Chattanooga & St. Louis maintains a rock crushing plant at Cumberland, Ala., which was opened in the early part of 1924 and is operated for the production of ballast for maintenance and construction purposes. It is conducted under the direction of the division engineer. The carrier took the position that the employees at this plant did not come under the provision of Title 3 of the Transportation Act of 1920 and would not grant a request of the employees that they be placed under the agreement for maintenance of way employees. The case was brought before the labor board by the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers and the board decided in favor of the employees.—Decision No. 3792.

Rate of Pay for Emergency Work

A bridge and building gang on the Great Northern was called out for emergency work at a sink hole at 9 p. m., and required to work continuously until 7 p. m. on the following day. The men were paid at the rate of time and one-half from 9 p. m. until 8 a. m. and straight time for the remainder of the tour of service, it being the contention of the railroad that this portion of the time employed fell within their regular service period. The employees, represented by the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers, contended that they should have been paid time and one-half for the entire period from 9 p. m. until 7 p. m. the following day. The decision of the Labor Board was that Rule 51 of the maintenance of way agreement applied in this case, and sustained the claim of the employees.—Decision No. 3678.

Water Service Men Changed From Hourly to Monthly Basis

Effective February 1, 1924, the Oregon Washington Railroad & Navigation Company notified three water service repair men, with headquarters at La Grande, Ore., but who are employed all over the line, that their rate of pay was to be changed from 60½ cents per hour to $126.64 a month, in accordance with Section 28, Article V of the agreement. As these men had been receiving overtime for all service performed in excess of eight hours and all time engaged in traveling, the change to the monthly basis resulted in an appreciable reduction in their earnings and they protested to the labor board through the Brotherhood of Maintenance of Way Employees and Railway Shop Laborers, it being the contention that this action was in direct violation of the letter and spirit of the agreement. The carrier took the position that the hourly basis of compensation was not in conformity with the rules and that they were therefore justified in making the change. The opinion of the board was that the service performed by these employees came within the language "assigned to duties requiring variable or intermittent hours, etc.," and under the technical application of the rules the new basis of compensation applied by the railroad was correct. The board's decision denied the request of the employees.—Decision No. 3727.

Personal Mention

General

R. W. Williams, engineer maintenance of way of the Southwestern district of the Southern, with headquarters at Chattanooga, Tenn., has been appointed executive general agent, with the same headquarters, succeeding **W. F. Fitton,** deceased.

Thomas Ahern, whose promotion to assistant general manager of the Northern district of the Southern Pacific, with headquarters at Sacramento, Cal., was noted in the July issue, was born on January 6, 1860, in Ireland. He entered railway service in December, 1881, as a laborer on the Western division of the Southern Pacific where he was later promoted to section foreman. He was promoted to roadmaster of the Western division in 1887 and in the following year was transferred to the Sacramento division. Mr. Ahern was transferred back to the Western division in 1892, where he remained until 1901, when he was promoted to general roadmaster. In July, 1905, he was promoted to general track inspector of the Central district, which position he held until September, 1906, when he was promoted to assistant superintendent of the Sacramento division. Mr. Ahern was promoted to superintendent of the Shasta division in October, 1907, and in July of the following year was transferred to the Coast division. He was transferred to the Sacramento division in October, 1921, where he remained until his recent promotion to assistant general manager.

E. L. Taylor, who has been appointed assistant to vice-president in charge of industrial development of the New York, New Haven & Hartford, is an engineer by training and experience. He was born on September 8, 1879, at Albany, N. Y., and received his elementary education at Albany Academy. He graduated from Sheffield Scientific School, Yale University with the degree of Ph.B., in 1901 and was an instructor in this institution from the time of his graduation until 1903, when he went to the University of Kansas as assistant professor of civil engineering. From 1904 until 1906 was instructor in civil engineering at Sheffield. In 1906 he served for a short time in the engineering department of the New York, New Haven & Hartford, and then entered the service of the maintenance-of-way department of the New York Central at Albany, N. Y. In 1908 he was promoted to assistant engineer at New York. In 1911 he entered the office of the designing engineer in charge of the company's West Side (New York City) improvements. In 1912 he became an assistant engineer in the office of the engineer, maintenance-of-way, of the New York, New Haven & Hartford. In the following year he was transferred to the staff of the general manager. In 1914 he was appointed contract agent of the New Haven and the Central New England, and remained in that capacity until the time of his recent promotion. Mr. Taylor served in the war as a first lieutenant of engineers, and at the present time is a major of engineers in the officers' reserve corps.

E. L. Taylor

W. H. Tobey, whose promotion from division engineer to superintendent of the Smithers division of the Canadian National, with headquarters at Prince Rupert, B. C., was noted in the June issue, was born at North Berwick, Me., on

January 15, 1880, and received his education at Brown University, Providence, R. I. Mr. Tobey entered railway service in 1902 as an instrumentman on location and construction on the Wabash in West Virginia in which capacity he served until 1904 when he became a draftsman on location on the Canadian Pacific in Ontario, later being promoted to resident engineer. From 1906 to 1910 he was resident engineer on construction on the Grand Trunk Pacific in Saskatchewan and British Columbia. In the latter year he was promoted to assistant engineer on construction which position he held until 1914 when he was promoted to resident engineer maintenance of way. In 1920 he became division engineer maintenance of way of the Smithers division of the Canadian National, with headquarters at Prince Rupert, B. C., in which capacity he was serving at the time of his recent promotion.

Engineering

I. D. Waterman, assistant to the chief engineer of the New York, New Haven & Hartford, has been appointed assistant chief engineer of this company and also of the Central New England.

F. S. Schwinn, chief engineer of the International-Great Northern, has been appointed assistant chief engineer of both the Gulf Coast Lines and the International-Great Northern, with headquarters at Houston, Tex.

J. R. Leguenec, roadmaster on the Stephenville district of the St. Louis Southwestern, with headquarters at Waco, Tex., has been appointed assistant engineer with a relocation party making surveys between Mt. Pleasant and Tyler, Tex.

R. Hayes, structural engineer on the Southern, with headquarters at Washington, D. C., has been appointed engineer maintenance of way of the Southwestern district with headquarters at Chattanooga, Tenn., succeeding **R. W. Williams,** promoted, as noted elsewhere.

A. J. Ciani, P. Fanger, J. P. Goggin and **E. P. McClain** have been appointed to fill four newly created positions of assistant engineers on general maintenance and constructio work on the Florida East Coast. Their headquarters will be at St. Augustine, Fla.

E. W. Robinson, division engineer of the North line of the Port Arthur division of the Canadian National, with headquarters at Fort William, Ont., has been given extended jurisdiction to include the entire Port Arthur division, succeeding **F. W. Leeper,** who has been transferred to the Smithers division, with headquarters at Prince Rupert, B. C.

C. R. Harding, consulting engineer of the Southern Pacific, whose headquarters were removed from New York to San Francisco recently, has now been appointed engineer of standards, with headquarters in the latter city. He will have supervision of standards other than those of the motive power department and will assist the president in engineering matters.

T. C. McCord, roadmaster on the Gulf Coast Lines, with headquarters at Harlingen, Tex., has been appointed division engineer on the San Antonio division of the Internatioal-Great Northern, with headquarters at San Antonio, Tex., succeeding **C. O. Hooper,** resigned. **F. H. Cook** has been appointed division engineer on the Texas division, with headquarters at Kingsville, Tex., a newly created position. **C. S. Colvin** has been appointed division engineer of the Louisiana division, with headquarters at DeQuincy, La., a newly created position.

L. J. Drumeller has been appointed assistant division engineer on the Chesapeake & Ohio with headquarters at Richmond, Va., to succeed **M. I. Dunn, Jr.,** who has been transferred to Huntington, W. Va., in place of **H. M. Church,** who has been promoted to division engineer, with headquarters at Hinton, W. Va., to succeed **J. E. King,** promoted to general supervisor bridges and buildings, as noted elsewhere in these columns. Mr. Church was born at Indianapolis, Ind., on November 6, 1881. He had an extensive experience with the Baltimore & Ohio in the capacity of district engineer maintenance of way and later as division engineer. During the period of federal control, he was appointed special engineer to the general managers in the Baltimore federal district. Mr. Church entered the service of the Chesapeake & Ohio in October, 1923, as assistant division engineer at Huntington, W. Va., where he continued to serve until his recent promotion, as noted above.

J. C. Wallace, whose promotion to assistant chief engineer of the New York, Chicago & St. Louis, with headquarters at Cleveland, was reported in the July issue, was born on November 1, 1886, at Harrisburg, Pa., and graduated from Pennsylvania State College in 1911. Prior to entering railway service he was a draftsman for the Pennsylvania Steel Company at Steelton, Pa., and also served as a draftsman and assistant engineer for the Falk Company, Milwaukee, Wis. He entered the service of the Chicago, Milwaukee & St. Paul in 1914 as designing engineer on track elevation at Chicago where he remained until 1918, when he left the St. Paul to become engineer of structures for the Lake Erie & Western with headquarters at Indianapolis, Ind., which position he held until 1924. From September, 1924, until June, 1925, he served as district engineer of the Lake Erie and Western district of the New York, Chicago & St. Louis, which position he was holding at the time of his recent promotion.

R. E. Van Atta, office engineer of the Kansas City Southern, with headquarters at Kansas City, Mo., has been promoted to engineering assistant to the vice-president and general manager, with the same headquarters, succeeding **S. E. Shop,** who has resigned to enter other service. **D. A. Kuebler,** roadmaster, with headquarters at Leesville, La., has been promoted to office engineer, with headquarters at Kansas City, Mo., succeeding Mr. Van Atta. Mr. Kuebler was born on May 7, 1888, at Waco, Neb., and graduated from the University of Nebraska in 1909. He entered railway service in 1910 as rodman on location and construction work in Nebraska and Kansas for the Missouri Pacific, which position he held until November, 1912, when he entered the service of the Kansas City Southern. From the latter date until his recent appointment he served continuously on the Kansas City Southern as rodman, transitman, roadmaster and assistant engineer on maintenance and construction, with the exception of four months in 1916 when he held the position of transitman on the Union Pacific on maintenance work in Wyoming and Utah.

Track

A. F. Collins, yard foreman of the St. Louis Southwestern, with headquarters at Tyler, Tex., has been appointed acting roadmaster on the Stephenville district, with headquarters at Waco, Tex., succeeding **J. R. Leguenec, promoted,** as noted elsewhere.

R. L. Huson, roadmaster on the Kansas City Southern at Shreveport, La., has been transferred to Leesville, La., succeeding **D. A. Kuebler,** promoted as noted elsewhere. **P. J. McCarthy,** assistant engineer on the staff of the chief engineer, has been promoted to roadmaster, with headquarters at Shreveport, La., succeeding Mr. Huson.

J. L. Gressitt, supervisor on the Philadelphia division of the Pennsylvania, has been transferred to the Monongahela division, with headquarters at West Brownsville, Pa., effective June 1, in place of **G. H. Schlotterer,** who has been appointed assistant supervisor at West Philadelphia, Pa. **C. T. Bishop,** assistant on the engineering corps of the Cleveland & Pittsburgh division, has been appointed supervisor, with headquarters at Ravenna, Ohio, effective June 16, succeeding **W. H. Saltsman,** who is on furlough on account of ill health. **A. W. Duke,** division engineer, with headquarters at Logansport, Ind., has been appointed supervisor of track at Downington, Pa.

F. J. Parkhurst, roadmaster on the Middle division of the Lake Erie & Western district of the New York, Chicago & St. Louis, with headquarters at Tipton, Ind., has been made supervisor of track on the Chicago division of the Nickel Plate district, with headquarters at Ft. Wayne, Ind. **W. S. Fife,** roadmaster of the Indianapolis division of the Lake Erie & Western district, with headquarters at Tipton, Ind., has been transferred to the Middle division, succeeding

Mr. Parkhurst. **G. C. McCorkle**, general foreman on the Ft. Wayne division, with headquarters at Muncie, Ind., has been appointed roadmaster on the Indianapolis division, with headquarters at Tipton, Ind., succeeding Mr. Fife. **J. H. Dunn** has been appointed general foreman on the Ft. Wayne division, with headquarters at Muncie, Ind., succeeding Mr. McCorkle.

T. D. Ruggles, division engineer on the Canadian Pacific, with headquarters at Medicine Hat, Alta., has been made roadmaster of the Suffield subdivision, with headquarters at Lomond. This is a new position brought about by the taking over of an extension from the construction department.

S. H. Scribner, assistant supervisor of bridges and buildings on the Boston & Maine, with headquarters at Salem, Mass., has been promoted to supervisor of track with headquarters at Rochester, N. H., succeeding **Edwin O. Wiggin** whose death was noted in last month's issue. **R. F. Macaulay**, transitman, has been promoted to assistant supervisor of track at Boston, Mass., succeeding **J. F. Talbot**, promoted to supervisor of track, with the same headquarters, to succeed John Talbot, deceased.

Bridge and Building

C. J. Griffin has been appointed assistant supervisor of bridges and buildings on the Boston & Maine, with headquarters at Salem, Mass., succeeding **S. H. Scribner** who has been promoted to supervisor of track as noted elsewhere in these columns.

J. E. King, division engineer on the Chesapeake & Ohio, with headquarters at Hinton, W. Va., has been promoted to general supervisor of bridges and buildings with headquarters at Richmond, Va., succeeding **G. E. Tebbetts**, who has resigned as noted elsewhere. Mr. King was born at Barboursville, W. Va., on March 1, 1884. He entered the service of the Chesapeake & Ohio in September, 1900, as a carpenter at Huntington, W. Va. Mr. King was subsequently promoted to building inspector, carpenter foreman, assistant engineer and supervisor of bridges, buildings and water supply. On July 1, 1918, he was promoted to division engineer with headquarters at Hinton, where he remained until his recent promotion to general supervisor of bridges and buildings, as noted above.

G. E. Tebbetts, general supervisor of bridges and buildings of the Chesapeake & Ohio, has resigned to take the position of engineer of structures on the Chicago Rapid Transit Lines. A sketch of Mr. Tebbitts railway career was published in the issue of February, 1924, page 81.

Purchasing and Stores

D. C. Curtis, general storekeeper, lines east, of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., has been promoted to chief purchasing officer, with headquarters at Chicago.

C. M. Barron, purchasing agent of the Cuba Railroad, has been appointed general purchasing agent of the Consolidated Railroads of Cuba, with headquarters at Grand Central Terminal, New York.

C. S. Burt, chief clerk to the lumber and tie agent of the Illinois Central and the Yazoo & Mississippi Valley, has been appointed superintendent of ties and treatment, with headquarters at Memphis, Tenn., succeeding **E. H. Bowser**, deceased.

Obituary

W. A. Pettis, general supervisor of buildings on the New York Central, Lines East of Buffalo, with headquarters at Rochester, N. Y., died suddenly in that city on July 7.

In order to reduce the fire hazard, the Denver & Salt Lake is equipping some of its section crews with fire fighting equipment and is having them follow all trains over their sections of the line where there is danger of forest fires being started from sparks from the locomotive. The danger of forest fires is particularly acute at the present time on account of a long draught.

Construction News

The Atchison, Topeka & Santa Fe has prepared plans for the construction of several miles of second track and passing tracks in the vicinity of Colton, Cal. A contract has been awarded to the McKee Construction Company, El Paso, Texas, for the construction of a 12-stall reinforced concrete roundhouse at Hutchinson, Kan., which will cost $100,000 This company will make improvements on the line of the Grand Canyon Railroad, a subsidiary, between Williams, Ariz., and the Grand Canyon, at a cost estimated at approximately $300,000. The plans for the improvement, which have not yet been completed, will include a power house of large capacity at Grand Canyon.

The Baltimore & Ohio has awarded a contract to the Vang Construction Company, Cumberland, Md., for the construction of a water supply reservoir at Lumbersport, W. Va., at a cost of approximately $28,000. A contract has also been awarded to the Pittsburgh Construction Company, Pittsburgh, Pa., for the erection of superstructures of two bridges on the line between Cincinnati and St. Louis. The new structures consist of plate girder spans, ranging in length from 40 to 97 ft.

The Bangor & Aroostook has awarded a contract to the Eyre-Johnston Company, Philadelphia, for the erection (labor only) of a marine pier at Searsport, Me., to cost approximately $350,000.

The Big Sandy & Cumberland, a subsidiary of the Norfolk & Western, has applied to the Interstate Commerce Commission for a certificate authorizing the construction of an extension from Hurley, Va., to a point on the eastern bank of Levisa Fork of the Big Sandy river, 14.08 miles, to cost approximately $2,500,000.

The Central of Georgia has awarded a contract to the W. P. Thurston Company, Inc., Richmond, Va., for an addition to the company's passenger station at Columbus, Ga., at a cost of approximately $40,000. The work will include new platforms and shelters. A contract for a 300-ton reinforced concrete coaling station at Albany, Ga., to cost about $37,000 has been awarded to Fairbanks, Morse & Co., Chicago.

The Chicago & North Western has been authorized by the Interstate Commerce Commission to extend its line from Wakefield, Mich., northwesterly 4.2 miles at an estimated cost of $213,600.

The Chicago, Burlington & Quincy has awarded a contract for the construction of a brick power house and the moving and resetting of four boilers at Galesburg, Ill., reported in the July issue, to G. A. Johnson & Sons, Chicago. A contract has also been awarded to Ernest Rokahr & Sons, Lincoln, Neb., for the construction of a passenger station, master mechanics' office building and store and oil house at McCook, Neb., to cost approximately $200,000. A contract has been awarded to the same company for the construction of a freight and passenger station at Pawnee, Neb. A contract has also been awarded to G. A. Johnson & Sons, Chicago, for the construction of a passenger station at LaGrange, Ill., to cost approximately $30,000.

The Chicago, Rock Island & Pacific has awarded a contract to the T. S. Leake Construction Company, Chicago, for the construction of a one-story repair shop, 100 ft. by 200 ft., in Chicago to cost $52,000.

The Cowlitz, Chehalis & Cascade will receive bids until July 15 for the construction of a 14-mile extension from Lacamas, Wash, to Mossy Rock.

The Dallas Union Terminal has received authorization for the construction of an addition to the concourse of the Union Station at Dallas, Tex., at a cost of $140,000. Two additional tracks will be added to the present station facilities.

The Erie has purchased approximately 150,000 sq. ft. of dock property on the north branch of the Chicago river for a consideration of $254,000 to be used as a site for a freight station. The present facilities have been greatly reduced by

the widening of Ashland avenue, Chicago. The New York Public Service Commission has approved this company's plans for eliminating a grade crossing at Foote avenue, Jamestown, N. Y. A contract for a large, modern pier at Jersey City, N. J., to replace facilities destroyed by fire last winter, has been awarded to Foley Brothers, New York, by this company.

The Great Northern has awarded a contract to Grant Smith & Company, St. Paul, Minn., for the grading and bridge construction on its 50 mile extension from Scobey, Mont., to Opheim, reported in the July issue. The extension will cost $1,500,000.

The Gulf Coast Lines have made surveys for a 30-mile branch from Edinburg, Texas, to Raymondville, with a total of 20 miles of short feeder lines.

The Houston & North Shore has been incorporated at Houston, Tex., and has obtained a charter to construct a railway from Houston to Goose Creek and Baytown, a distance of 30 miles. R. W. Franklin and Harry K. Johnson, Houston, are two of the incorporators.

The Illinois Central will remodel the roundhouse of the Yazoo & Mississippi Valley at Natchez, Miss. A contract for masonry and carpenter work on the superstructure of the shops at Markham Yard, Chicago, has been awarded to W. J. Zitterell, Webster City, Ia. A contract for the construction of a superstructure of a roundhouse and machine shop at Sioux City, Ia., reported in the July issue, has been awarded to the Grant Smith Company, St. Paul, Minn.

The Illinois Terminal has purchased seven miles of the line of the St. Louis, Troy & Eastern between Edwardsville, Ill., and Troy for $200,000. The construction of an extension to a point near O'Fallon, Ill., at a cost of $600,000, is contemplated.

The Indiana Harbor Belt is receiving bids for the construction of a pumping plant and reservoir at Belmont Avenue, Chicago.

The International Great Northern has received bids for the construction of a suburban passenger station at North San Antonio, Tex., to cost $37,000. The building will be of concrete and brick, with tile roof. The project includes the development of the station grounds, platforms, driveways, etc.

The Kansas City, Mexican & Orient has a locating party making surveys for a proposed extension from Alpine, Tex., to the Rio Grande at Presidio. Surveys are also being made for a branch from San Angelo, Tex., to Del Rio, and for a line from Foley, Okla., to Ewing, between which points the Orient now operates over the tracks of the St. Louis-San Francisco.

The Long Island's plans for the elimination of a grade crossing at Southold, L. I., have been approved by the New York Public Service Commission.

The Los Angeles & Salt Lake has awarded a contract to the Lynch Construction Company, Los Angeles, Cal., for the construction of a freight station, 312 ft. by 34 ft., together with additional yard tracks and loading platforms, at Pasadena, Cal.

The Louisiana Railway & Navigation Company has applied to the Louisiana Public Service Commission for permission to relocate its line between Moreauville, La., and Naples, a distance of 18 miles, to replace the present line which would be abandoned. The proposed line would eliminate long ferry haul between Naples and Angola in the Mississippi and Red rivers.

The Main Central has received authorization for the reconstruction of its Skunk Hill bridge at South Portland, Me., at an approximate cost of $120,000.

The Missouri Pacific has awarded a contract to Walter Denison, Cushman, Ark., for the grading of 10 miles of second track between Cypress Junction, Ark., and Benton, reported in July issue. The ballasting and rail laying will be done by company forces. The total cost of the project will be $395,000. A contract has been awarded to Jerome A. Moss, Chicago, for the construction of a one-story concrete and steel machine shop at Bush, Ill. A contract for the construction of a six-stall concrete roundhouse at Bush has been awarded to H. O. Hirsch Construction Company, St. Louis, Mo.

The Mobile & Gulf has applied to the Interstate Commerce Commission for a certificate authorizing the purchase of a line running from a connection with the Southern at Fayette, Ala., southerly 29 miles and an extension of the line to a connection with the Mobile & Ohio at Buhl, Ala., 3 miles, making a total of 32 miles which the company desires to operate.

The National Railways of Mexico plan improvements to the line from Guadalajara, Jalisco, to Manzanillo, a distance of 357 miles, to restore it to good condition. In connection with the project, breakwaters and wharves will be constructed at Manzanillo.

The New York Central has awarded a contract to H. H. Sherwin & Co., Inc., New York, for the remodeling of the company's stockyards and the construction of additional platforms and paving for the handling of chickens of its Sixtieth street, New York, terminal at an approximate cost of $110,000. A contract has been awarded to the Link Belt Company, Chicago, for the remodeling and repair of the company's unloading tower at Pier 11, West New York, N. J., at an approximate cost of $30,000. The Public Service Commission of New York has issued an order directing the New York Central to prepare plans for the electrification of its line from Spuyten Duyvil creek south to its Sixtieth street yard in New York City. Plans and specifications are to be filed by September 1. The company is also required to submit by September 1 a statement of detailed plans showing the method by which it will electrify its lines in New York City from the Sixtieth street yard south to its freight terminal at St. John Park. Under the law as it now stands all lines in New York City must be electrified by January 1, 1926, but definite plans for the N. Y. C.'s west side line have been held in abeyance pending agreement with the city authorities with reference to grade separation on this line. The Public Service Commission of New York held a hearing on July 8 on the application of this company for an order directing the elimination of four grade crossings, one each at Unionville, Guilderland Center, Fullers and Rotterdam.

The New York, New Haven & Hartford has awarded a contract to Henry R. Kent & Co., Rutherford, N. J., for the construction of an additional building, approximately 150 ft. by 375 ft., for its shops at Van Nest station, New York City.

The Pennsylvania has awarded a contract to the John F. Casey Company, Pittsburgh, Pa., for the demolition of a portion of the Grant street freight station, that city, and the removal of tracks adjacent thereto. This work is preliminary to extensive terminal improvements in Pittsburgh. The Public Service Commission of Pennsylvania has ordered the elimination of the grade crossing at Market street, Marcus Hook, Pa., by the construction of an overhead bridge. The cost will be approximately $350,000, of which three-quarters will be borne by the railroad and one-fourth by the local authorities.

The Public Belt of New Orleans has received permission from the War Department for the construction of a bridge across the Mississippi river at New Orleans, La. The proposed structure will have central spans 790 ft. long with a vertical clearance of 130 ft. above mean gulf level. On each side of this span there will be a through span 530 ft. long on a grade of 1.25 per cent, making a net clearance of approximately 123 ft. at the shore end of each of the two spans. The next spans on each side will be of deck type, 530 ft. long, each of which will be flanked at its outer end by a deck span 335 ft. long. The remainder of the proposed bridge on either side, which will extend back of levees, will be of steel viaduct construction.

The Quanah, Acme & Pacific has applied to the Interstate Commerce Commission for a certificate authorizing the construction of an extension from MacBain to Floydada, Tex., 27 miles.

The Seaboard Air Line has awarded a contract for a reinforced concrete coaling station at Baldwin, Fla., to Fair-

banks, Morse & Co., Chicago. Sutton Brothers, Jacksonville, Fla., have a contract for grading and the laying of additional tracks at the same point. A contract has been awarded to C. V. York, Raleigh, N. C., for the construction of several buildings at this point.

The Southern has received bids for the construction of a steel coaling station at Mount Vernon, Ill.

The Southern Pacific, if its plans for the acquisition of substantial interests in the Nevada-California-Oregon and the Oregon, California & Eastern, are approved by the Interstate Commerce Commission, plans to construct an extension of the latter road from Sprague River, Ore., the present eastern terminus, east to Lakeview where connection will be made with the Nevada-California-Oregon. In conjunction with its own Natron cutoff, these links will provide a new route from Oregon to the east. The Interstate Commerce Commission has authorized this company to extend its Lodi branch from Valley Spring station, Cal., to the north fork of the Calaveras river, a distance of 8.1 miles, at an estimated cost of $581,202, including right-of-way. This company contemplates the construction of a secondary main line from Niland, Cal., to Salton, a distance of 30 miles, which will follow the old line of the railway used prior to the flood of 1905. The proposed line will be approximately four miles shorter than the one now in use.

The Texas & Pacific will soon receive bids for the construction of the superstructures of a machine shop and a roundhouse at Shreveport, La. As reported in the March issue, the development project at Shreveport will cost a total of $925,000.

The Union Pacific is taking bids for the construction of a storehouse, 40 ft. by 316 ft., at Council Bluffs, Iowa, to cost approximately $60,000.

Equipment and Supplies

The Boston & Maine is inquiring for three 25-ton locomotive cranes.

The Canadian National is inquiring for one 35-ton locomotive crane.

The Chesapeake & Ohio has ordered 7,500 kegs of spikes and bolts from the Tredegar Company, Richmond, Va.

The Chicago, Aurora & Elgin is inquiring for 1,200 tons of rail for new line.

The Chicago, Rock Island & Pacific has divided an order for 6,500 kegs of spikes and 6,000 kegs of bolts between the Inland Steel Company and the Illinois Steel Company.

The Georgia, Florida & Alabama has ordered one standard ditcher from the American Hoist & Derrick Company.

The Great Northern is inquiring for 5,000 kegs of spikes and bolts.

The Illinois Central has ordered 4,000 tons of tie plates from the Sellers Manufacturing Company.

The International Railways of Central America have placed an order for 2,300 tons of rail.

The Lehigh Valley is inquiring for two 35-ton locomotive cranes.

The Louisville & Nashville has ordered 7,500 kegs of spikes from the Tennessee Coal, Iron & Railroad Company.

The Missouri Pacific has divided an order for 3,800 kegs of bolts and 2,000 kegs of spikes between the Inland Steel Company, the Illinois Steel Company, the Tennessee Coal, Iron & Railroad Company and the Jones & Laughlin Steel Corporation.

The National Railways of Mexico are inquiring for 1,250,000 tie plates.

The Norfolk & Western has ordered 27,000 tons of rail from the Carnegie Steel Company and 20,000 tons from the Bethlehem Steel Company. This company is inquiring for 15,000 kegs of spikes and bolts.

The St. Louis-San Francisco is inquiring for 15,000 tons of rails.

The St. Louis Southwestern is inquiring for 15,000 kegs of spikes, and 15,000 tons of 90-lb. rail.

Supply Trade News

General

The Long Bell Lumber Company has awarded a general contract to Grant Smith & Company for 12 one-story additions to its mill at Longview, Wash., to cost approximately $300,000.

The Cleveland Crane & Engineering Company, Wickliffe, Ohio, has appointed the following representatives; the **Kirby Machinery Company,** Toledo, Ohio, the **J. H. Overpeck Company,** Pittsburgh, Pa., the **A. D. Heath Machinery Company,** Indianapolis, Ind., **Julius Andrea & Sons,** Milwaukee, Wis., and the **D. H. Braymer Equipment Company,** Omaha, Neb.

The French Battery & Carbon Company, Madison, Wis., has been reorganized as the French Battery Company and refinanced to enable it to enlarge its output of dry batteries and flashlights. The additional capital will permit this company to make additions to its plant and enlarge its warehouse facilities and equipment.

The Taylor Wharton Iron & Steel Co., High Bridge, N. J., and **Wm. Wharton, Jr., & Co.,** Easton, Pa., have reorganized their method of sales representation in New York City by making a commission office of it under the direction of **C. N. Shaffner,** formerly northeastern sales manager of these companies. Under the new arrangement, Mr. Shaffner has associated with him, **W. H. Allen** also formerly with the sales organization of the above mentioned companies, the two forming a partnership knows as **Shaffner & Allen,** and utilizing the former offices and facilities of the Taylor Wharton Iron & Steel Co., and Wm. Wharton, Jr., & Co., at 50 Church street. The newly organized sales office will also handle the New York and other eastern territory sales for the Ashland Firebrick Company, Ashland, Ky.; the Lang Broom Company, Pittsburgh, Pa.; Samuel Peterson, Inc., Warren, Pa.; and the Northwestern Motor Company, Eau Claire, Wis.

Personal

W. D. Horton, western railway representative of the **Murphy Varnish Company,** at Chicago, has been appointed manager western railway sales, with headquarters at 50 West Twenty-second street, Chicago. From 1908 to 1914 he was associated with the Simmons Boardman Publishing Company, New York, as traveling subscription representative and on April 1, 1914, was appointed circulation manager, which position he held until March 1, 1919, when he resigned to go as district railway sales manager to the Patton Paint Company. On December 1, 1919, he resigned to become associated with the Murphy Varnish Company as western railway representative, which position he held until his recent promotion. Mr. Horton spent several years previous to 1908 selling various commodities such as stationary engines, boilers, wood-working and other machinery. In this work he traveled extensively in North America, the West Indies and in Central and South America.

W. D. Horton

Elmer E. Ross, a director of **The Positive Lock Washer Company,** Newark, N. J., has been elected president to succeed **George Hendricks Denman, Sr.,** who died on April 17. Mr. Ross is the son of the late John B. Ross, originator of

and former president of the Positive Lock Washer Company. Elmer E. Ross started with the company in 1903, working up to assistant secretary. In 1912 he resigned to go into the lumber business, which interest he still holds, being treasurer of the National Box & Lumber Company, Newark, N. J. In December, 1919, Mr. Ross was elected a director of the Positive Lock Washer Company.

J. R. McGinley, who was recently elected chairman of the board of the **Duff Manufacturing Company,** as mentioned in last month's issue, served as president of the company for nearly 25 years previous to his election as chairman. He has been identified with manufacturing industries for many years, prominent among which are the Westinghouse interests. Until recently he was also chairman of the board of the Chicago Pneumatic Tool Company. **Thomas A. McGinley,** who was elected president of the company, as stated in last month's issue, is also a director of the Westinghouse Air Brake Co. and the Union Switch & Signal Company of Pittsburgh.

J. R. McGinley

He has been associated with the Duff Manufacturing Company for over 20 years, and for the past 10 years has been vice-president and general manager. **P. G. O'Hara,** whose appointment as vice-president appeared in the July issue, was for a number of years associated with the Galena Signal Oil Company, first located in New York City and later as

C. N. Thulin

Thomas A. McGinley

district manager at Cincinnati. As vice-president of the Duff Manufacturing Company he will be in charge of their eastern sales division, comprising the eastern, southeastern, central and southern district offices. His headquarters are in New York City. **C. N. Thulin,** whose appointment to vice-president in charge of the western sales division was reported in the July issue, has represented the Duff Manufacturing Company for the last 10 years as district manager in the Chicago district. In his new position he has jurisdiction over the main offices and representatives in the middle west, south west, Mountain states and Pacific coast. His headquarters are at Chicago.

Carl A. Methfessel, manager of sales, eastern district of the Duff Manufacturing Co., died of heart trouble on July 22, 1925, at his home at Ridgefield Park, N. J. Mr. Methfessel was born 48 years ago and had been associated with the company for 15 years. He had been formerly connected with the Delaware, Lackawanna & Western.

H. C. Boyden, lecturer for the Portland Cement Association on subjects pertaining to the proper use of concrete, has resigned to become dean of the engineering department of Ohio Northern University, Ada, Ohio.

Henry S. Mann, for many years district manager in charge of the Chicago office and shops of the Metal & Thermit Corporation has resigned to become district sales manager of the **Standard Stoker Company, Inc.,** New York. Mr. Mann will have his headquarters in the McCormick building, Chicago. Previous to entering the service of the Metal & Thermit Corporation he had been connected with a number of railways, serving as a locomotive engineer with the Boston & Maine, the Northern Pacific, the Atchison, Topeka & Santa Fe and the Wabash. He has served as a director of the National Railway Appliance Association of Chicago; vice-president of the American Welding Society and vice-president of the International Railroad Master Blacksmiths' Supplymen's Association.

Trade Publications

The Drill for Today.—In a 16-page pamphlet the Detroit Twist Drill Company, Detroit, Mich., presents an interesting account of the development of the idea of the twist drill made by rolling and twisting instead of milling. It presents a fund of information on the subject of drills that is entirely new to the average user.

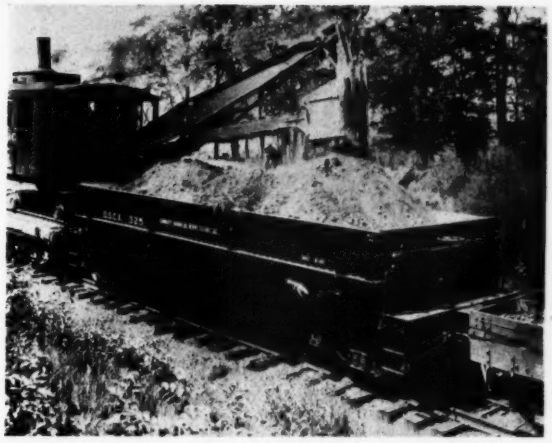
Cinder Plants.—In a 12-page folder Roberts and Schaefer Company, Chicago, presented a demonstration of the various adaptations of its N & W cinder plant. These cover the range embraced by the N & W Junior plant designed for light service and those installations designed to serve a number of tracks with one or more dumping points on each track. They cover also the use of the N & W idea in a combined cinder loading and coaling plant.

Section Gang Car.—Fairmont Railway Motors, Inc., Fairmont, Minn., has issued an eight-page bulletin describing its section gang motor cars known as the S2 and ST2. These two cars have been designed to obtain light weight to facilitate removal from the track by two men and yet be capable of carrying eight to ten men. The S2 car is a single speed car, while the ST2 has a two-speed transmission. The bulletin gives detailed descriptions of the various parts of the equipment with specifications and photographs showing the cars equipped with various types of safety railings.

Treated Timber.—The Protexol Corporation, New York, has issued Bulletin 40 containing a discussion of the economics of timber treatment by E. F. Paddock and in addition some demonstrations of the value of brush and open tank treatment with Protexol and Neosote, coal tar wood preservatives manufactured by that company. The bulletin is illustrated with photographs of timbers that have given long life after treatment.

The Jordan Spreader.—In a 24-page catalog the O. F. Jordan Company, East Chicago, Ind., presents a remarkably clear exposition of the purposes and operation of the Jordan spreader. It shows by text and illustrations how this equipment is used for spreading material unloaded from cars, for widening embankments, ditching, the disposal of snow in yards, ice cutting, etc. It includes typical cross sections of roadbeds, tables of dimensions and a list of the railroads, contractors, mines and industries which are making use of this equipment.

Cleveland Twist Drill Catalog.—The Cleveland Twist Drill Company, Cleveland, Ohio, has issued Catalog No. 41, a book of 244 pages, which covers a complete line of drills manufactured by this company. In addition to illustrations and tables of dimensions and sizes of the various drills this catalog contains much information of value to users of drills, tables of cutting speeds, etc. A number of new items on the list of this manufacturer's products are covered in this catalog for the first time.



24-yd. car loaded full length with standard ditcher. Crown load, 35 cu. yds.

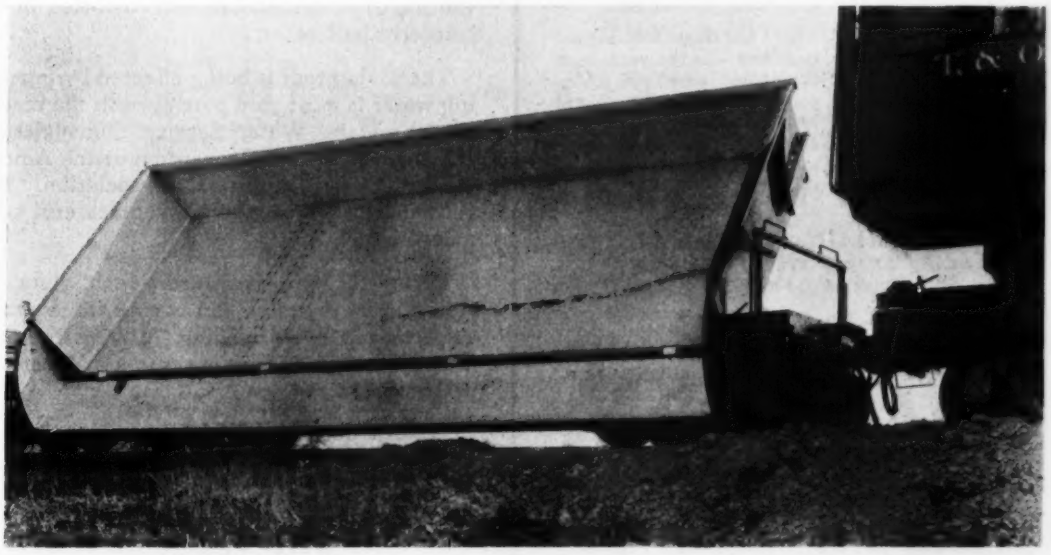
The load is cast well away from the track and dumping action is quick and certain. Passenger trains can follow immediately without spreading and the ballast is protected.

DIFFERENTIAL AIR DUMP CAR FOR DITCHING

Low height (only 7′ 4″ from rail) allows easy and full loading. No booming up.
Dumps load well beyond track. Protects ballast and allows other trains to follow immediately.
Body supported at four points directly over bolster side bearings.
Entire absence of locking mechanism. Rides steadily in train at high speeds.
Dumping is quick and certain. No shock to damage car, track, or trestles.
Rugged construction, fewer parts, and utter simplicity of design give long life and minimum maintenance.
Dumps to either side without changing cylinders or any other mechanism.
Standard sizes (level load) 24 cu. yds. and 30 cu. yds.

Complete description in Bulletin D-15.

THE DIFFERENTIAL STEEL CAR CO.
FINDLAY, OHIO



Clear opening, smooth floor, and steep discharge angle insure clean dumping of all classes of material including huge boulders and very sticky clay.

1 Fifteen Parts in One
The one piece construction avoids the high cost of installing and need of frequent maintenance found in ordinary guard rail.

2 Lug Design *[distinctive with* ACCO*]*
The lugs engage the under side of the head of the traffic rail, preventing overturning of the guard rail.

3 Renewable Face
The manganese steel inserts insure long life and at the same time make possible easy replacement.

ACCO
A PRODUCT OF THE AMERICAN CHAIN COMPANY, Inc. in business for your safety

This stops another *maintenance problem*

One-Piece Guard Rail eases the battle for safe, well-kept track at less cost.

A one-piece guard rail with renewable manganese steel face is about the most lasting piece of equipment you can put on the right-of-way. And it requires practically no maintenance, as contrasted with the constant adjustment necessary on ordinary rail—the realignment for proper flange-way—the renewal of foot guards—new installations when ordinary rail wears out.

The single open hearth casting of ACCO One-Piece Guard Rail combines guard rail, clamps, tie-plates, flange-way lugs, foot-guards—everything. It is almost as easily installed as the traffic rail alone. And in the end it's the most economical installation you can find.

Try ACCO Guard Rail on your main line—in the yards—on the hardest guard rail job on your road. Write for illustrated folder describing its advantages. If you want prices, too, please give rail specifications.

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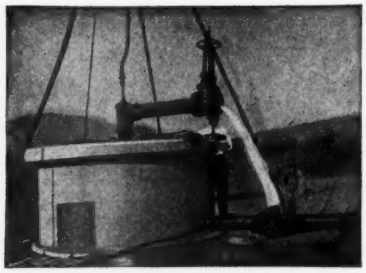
ACCO One-Piece GUARD RAIL



Natural flow before "back blowing."

CLEAN YOUR WELLS and KEEP them CLEAN

How much is your water supply curtailed by sand or mud accumulations? Do your pumps wear out or require frequent cleaning from this cause?

A SULLIVAN AIR LIFT

and properly applied "Back Blowing" will remove sand and mud troubles and permanently increase the flow from your wells.

Clean wells form but one of many advantages of The Sullivan Air Lift

Ask for new Railway Bulletin No. 19129

Sullivan Mch'y. Co.
411 Gas Bldg.
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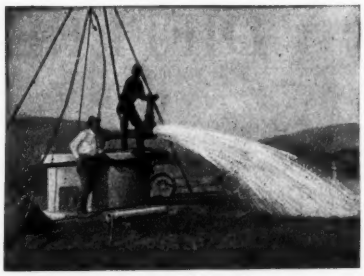

Flow from well after "back blowing."

Lime-Soda Water Softeners

We make LIME-SODA WATER SOFTENERS of both the ground operated and top operated types to purify water for prevention of scale deposits and corrosion in locomotive boilers.

The saving that is being effected by purifying water is most ably portrayed in the recent report of the Water Service Committee at this year's Chicago Convention of the American Railway Engineers' Association. We recommend this report for your careful consideration.

Write for our literature which gives, in detail, the results of our twenty-three years' experience in furnishing WATER SOFTENER PLANTS to twenty-six American Railroads.

American Water Softener Company
Fairhill P. O. Philadelphia, Pa.
Specialists for twenty-three years in Railroad
Water Purification

Stop! wasting money on

R.R. RAIL ROAD CROSSING INGS

BITUROC Crossing, Fortville, Ind.

Construct Them With

BITUROC
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Natural Kentucky Rock Asphalt

BITUROC Crossing, Cincinnati, O.

Bituroc is a natural bituminous sandstone quarried and pulverized at our plant at Summit, Hardin County, Kentucky.

Bituroc is the most practical pavement for railroad crossings because it is delivered on the job ready to be laid COLD. Any section crew with the aid of rakes and a roller (large one not necessary) can lay it satisfactorily.

Bituroc is waterproof, noiseless, dustless and exceptionally non-skid.

Bituroc, due to its elasticity and resiliency, will withstand the vibration and impact of combined vehicular and rail traffic, where a more rigid type of pavement will crack and disintegrate under the strain.

Bituroc is also used extensively for station platforms, roadways, walks, etc.

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The Composite Spreader-Ditcher, which is the Jordan Spreader with the composite Spreader-Ditcher Attachment, performs all the functions of the Spreader (moves earth, spreads bulky materials, plows snow) and in addition will shape the ballast and subgrade, form new ditches or clean old ones, and trim the banks of cuts to a uniform slope.

JORDAN SPREADER
"Does the Work of an Army of Men"
SNOW PLOW ICE CUTTER UNIVERSALLY STANDARD DITCHER
O. F. JORDAN COMPANY
WALTER J. RILEY, PRESIDENT
EAST CHICAGO, INDIANA

An all-year Machine. In use on North America's leading railroads.

Write for Copy of New Catalog

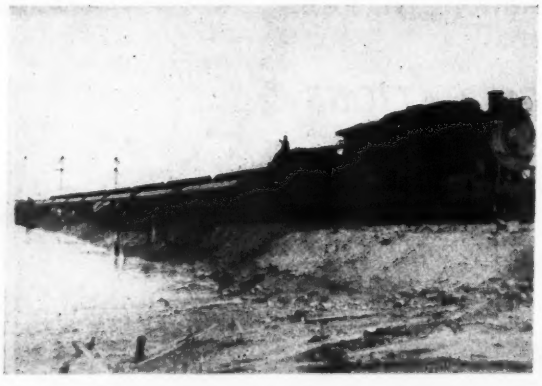
STURDY AND RELIABLE
LUFKIN TAPES

In Patterns Best for Every R. R. Requirement—Surveying—Engineering—Construction—M. of W. Steel Tapes with *Instantaneous* Readings and Nubian Finish. **Michigan Chain** (Chicago Style) **Tapes** with ½ gage mark and improved pattern reels.

Among our popular woven lines are the **"Metallic,"** and the low priced tapes for all common uses, the **Ass Skin,** and the **Universal No. 733R Linen Corded** with **First Three Feet Reinforced.**

STOCKED BY RAILWAY SUPPLY AND HARDWARE HOUSES.

Send for Catalogue THE LUFKIN RULE CO. **SAGINAW, MICH.** New York Windsor, Ont.



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Dump Cars for Mining—Railroad and Industrial Service.
30 - 20 - 12 - 8 yards capacity.
20 to 75 tons—A. R. A. Standard throughout.
Magor improved designs.
Using Magor patent compression locks and air operation.
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Cars equipped with lift doors and aprons or with bottom hinged doors.

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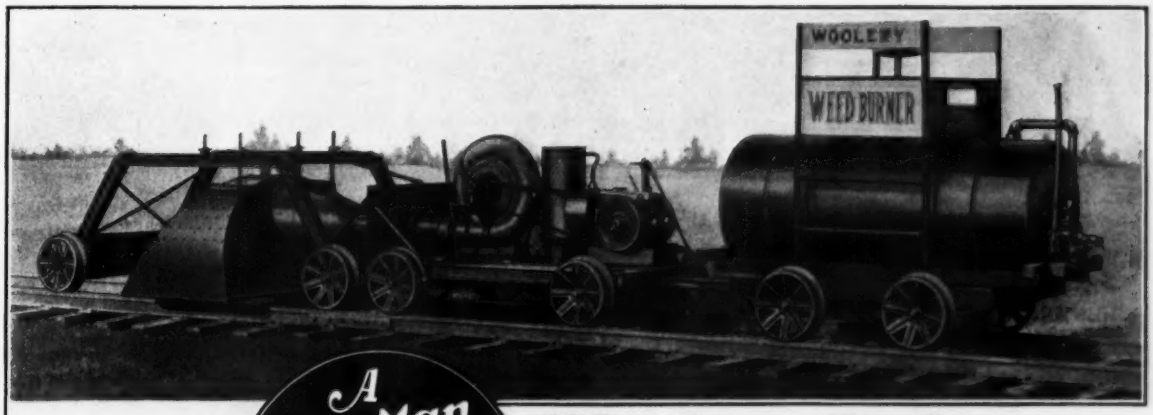
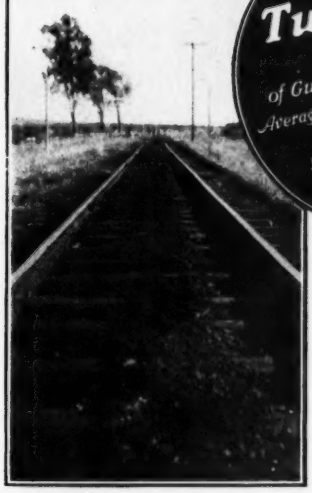


A Two-Man Outfit of Guaranteed Efficiency
Average cost on first heavy burning less than
$3.00 per mile



Note the clean, wide burned area that the Woolery leaves behind. In some places the weeds and crack grass had attained a height of 27 inches.

Woolery Railway Weed Burner

(Patent Applied For)

A self-propelled, three-unit outfit operated by two men. Speed from 1 to 5 miles per hour for burning, and up to 20 miles an hour for traveling. Compared with large and cumbersome machines, the Woolery is light—quick—nimble. Being easy to handle and quick to fire it gets around and can be used in places and on short burnings where other machines would be impractical. It may be removed from track at highway crossings. Total length of outfit, about 34 feet.

High Lights on the Woolery Weed Burner:

A Three-Unit outfit operated by TWO men.
Burns Gas Oil, Distillate Oil or Kerosene, and fire starts instantly.
ONE large Oil Burner—never whips out by tall weeds.
Burns a strip 11 feet wide.
Average burning rate, 2 miles per hour.
Fire may be shut off when crossing bridges. No drip of oil.
Fire relights automatically when fuel is turned on.
Outfit carries supplies for a full day's operation.
Any speed from 1 to 20 miles per hour on its own power.
Easily loaded on a flat car for long moves.
Operation is simple and easily learned.
All steel construction—safe and dependable.
Low fuel consumption, thoro work, and no train crew.
A clean, dry, withering hot fire—leaves no oil on the rails.
Four-Wheel Drive and Four-Wheel Brake—ample traction and safety.
Chrome Nickel Steel Ball-Bearing Axles—Strong and Easy-Running.
Entire workings of machine controlled from Driver's seat.
It may readily be removed from track at a highway crossing.

Always Ready for a Demonstration on Any Railroad

For Further Information, Write

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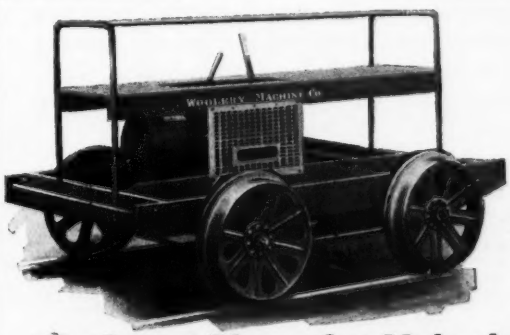


The Woolery (Model M) Railway Motor Car

Light in Weight—100 Per Cent Overload

A car for every road—for any Climate—for all kinds of Service. Power to meet requirements. It can be used as Section Car, Extra Gang Car or Small Work Train. Normal Capacity, 10 passengers. Instantly removable side seats which increases the seating capacity to 20 men, can be supplied. Chrome Nickel Steel Ball-Bearing Axles. Steel Hand Railing and Lift Handles, Steel Engine and Wheel Guards. Steel Truss Frame contributes enormous strength.

The Power Plants that Make the "Woolery" the Marvel of the Railway World

The Woolery Model "C" Reversible Engine

A powerful, light weight ball-bearing engine with speed control of from 400 to 1200 revolutions per minute. Develops 9 horse power on the brake test. Designed to use gasoline, but works efficiently on a mixture of kerosene and gasoline.

The Woolery Model "TC" Twin Cylinder, Reversible Engine with Two-Speed Transmission

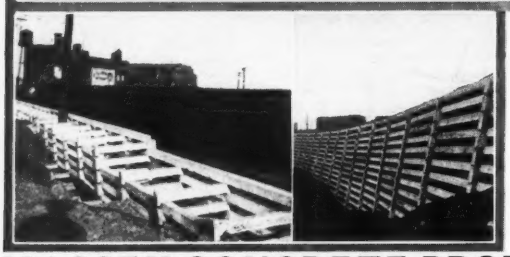
Ball-bearing, perfectly balanced, and smooth running. Develops 18 horse power on the brake test. Admirably adapted to the heavier class of section and construction work, and is powerful enough to save a work train many trips.

The Woolery Model "C" Reversible Engine 9 h. p. on the Brake Test

Write for Full Information and Detailed Description of Woolery Railway Motor Cars and Engines

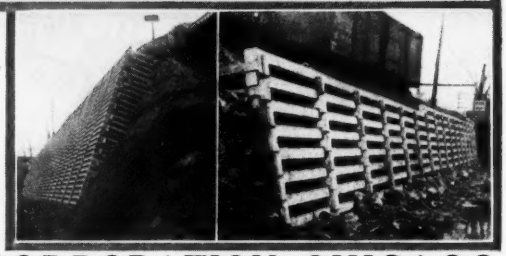
The Woolery Machine Co., Minneapolis, Minn.

KONKRETE KRIBBING



FOR ANY RETAINING WALL USE

Economical
Permanent
Easy to Install
100% Salvage



MASSEY CONCRETE PRODUCTS CORPORATION, CHICAGO

BERG
CONCRETE SURFACER AND FINISHER

For Elimination of Fins, Board or Form Marks, and All Surface Irregularities.

The BERG is the most satisfactory and efficient tool for surfacing and finishing all kinds of concrete construction. Cuts time, labor and other costs. Used on buildings, bridges, walls, culverts, dams, foundations, monuments, etc. Adapted for interior and exterior work.

Central Heating Station at Mariemont, Ohio, one of the largest community developments in the country.
M. J. Roche Construction Co., Cincinnati, General Contractors.
Fay-Spofford & Thorndike, Boston, Mass., Consulting Engineers.
Three BERGS were used to remove fins and board marks from both interior and exterior.

The BERG is portable, light weight, of simple construction, easily handled. Can be operated on alternating or direct current. Supplied for either 110-125 or 220-250 voltage.

Write for list of prominent users and full information.

The Concrete Surfacing M'chy. Co.
Department G
4669 Spring Grove Ave.
Cincinnati, Ohio

Why Genasco?

There must be a reason—when railroads are applying the acid test of economy in buying materials—that Genasco Asphaltic Protective Products are now standard on the leading railway systems of the United States. Complete details on any or all of the following products sent on request.

Trinidad Lake Asphalt
Trinidad Lake Roofing Asphalt (For Built-up Roofing)
Bermudez Road Asphalt
Genasco Tile Cement
Genasco Ready Roofings (Smooth and Slate Surface)
Genasco Sealbac Shingles (Individual and Strip)
Genasco Latite Shingles
Genasco Standard Trinidad Built-up Roofing
Genasco Membrane Waterproofing
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Genasco Rustless Slushing Compound
Genasco Mastic Flooring
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Genasco Liquid Asphalt Roof Coating
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Genasco Battery Seal Asphalt
Genasco Battery Paint
Genasco Asphalt Putty
Genasco Acid-Proof Paint
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Genasco Deadening Felt
Genasco Insulating Paper
Genasco Red Sheathing Paper
Genasco Stringed Felt
Genasco Stucco Base
Barber Brand Cold Repair Cement (For more permanent crossings than wooden planks and for platform construction)
Genasco Acid-Proof Mastic
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THE BARBER ASPHALT COMPANY

Land Title Building, Philadelphia

New York Chicago Pittsburgh St. Louis Kansas City San Francisco

WHARTON

Trackwork

IS known the world over—for since the beginning of the railroad industry this company has been inseparably associated in the design and application of better trackwork.

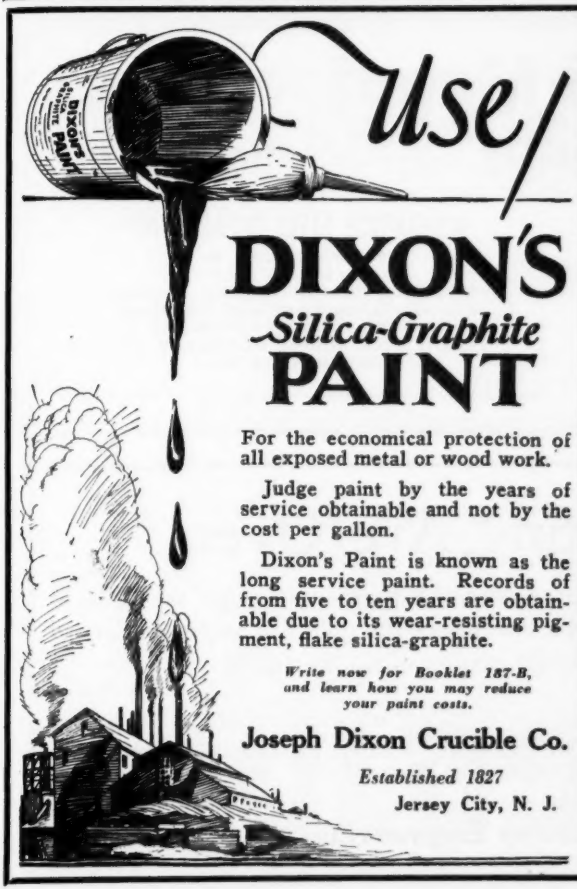
The severest pounding of modern power only serves to demonstrate the greater endurance of Wharton equipment.

We are prepared to furnish designs suited to individual standards of railroads or special designs as requested.

Switches—Frogs—Crossings—of TISCO Manganese Steel

Wm. Wharton Jr. & Co., Inc.

Easton, Pa.



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DIXON'S *Silica-Graphite* PAINT

For the economical protection of all exposed metal or wood work.

Judge paint by the years of service obtainable and not by the cost per gallon.

Dixon's Paint is known as the long service paint. Records of from five to ten years are obtainable due to its wear-resisting pigment, flake silica-graphite.

Write now for Booklet 187-B, and learn how you may reduce your paint costs.

Joseph Dixon Crucible Co.

Established 1827

Jersey City, N. J.

LAYNE WELL SYSTEM

FOR THE

DESERT LOCOMOTIVE

Even a camel, the famous desert locomotive, has to drink when he pulls into the City of Tunis, Africa, at the end of his long, sandy run.

In the picture below is the old aqueduct built by the Romans in the first century to bring water into the city. Old methods pass, and

Tunis has contracted with Layne Engineers to develop a modern guaranteed ground water supply for its 200,000 inhabitants.

The first well site was chosen by the Layne Engineers to be located close to the old Roman aqueduct where the dark spot appears on it in the picture.

LAYNE & BOWLER CO.

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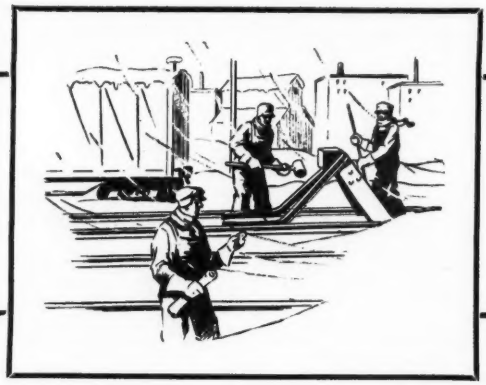


When the Ground Is Frozen

Don't forget that the bumping post installed in a blazing August sun may have to be moved six months later when the only thing the men can take an interest in is getting back to the lee side of a hot stove.

If it's a Durable, it's all above the ground and they can move it whenever the chief says, "Move". No undue profanity is required, no excavation of frozen ground, a minimum number of parts to handle.

This is only one of the advantages of the Durable Bumping Post. Its strength, ease of installation, minimum track occupancy, long life, absence of maintenance—all these and other features deserve your careful consideration. May we tell you the whole story?

MECHANICAL MANUFACTURING CO.

Also Manufacturers of the Ellis Bumping Post

PERSHING ROAD AND LOOMIS STREET, CHICAGO

The Frog, Switch & Manufacturing Company

Carlisle Pennsylvania

Established 1881

FROG AND SWITCH DEPARTMENT

MANUFACTURERS OF
MANGANESE INSERT FROGS, CROSSINGS AND SPLIT SWITCHES
SOLID MANGANESE FROGS AND CROSSINGS
PLAIN FROGS, SWITCHES, CROSSINGS
SWITCH STANDS AND ACCESSORIES

MANGANESE STEEL DEPARTMENT

MANUFACTURERS OF
"INDIAN BRAND"
HIGH GRADE MANGANESE STEEL CASTINGS
FOR FROGS, SWITCHES AND CROSSINGS
JAW AND GYRATORY CRUSHERS
CEMENT MILL, MINING MACHINERY, ETC.
GRAY IRON CASTINGS

The Days of Prospecting Are Over

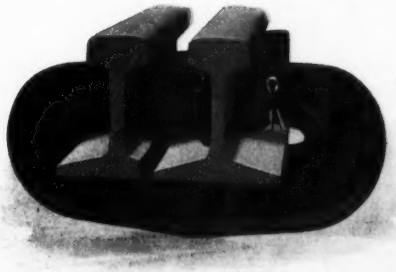
No longer do the prospector and the pack mule roam the hills in search of gold—wise men know where the gold lies and steady, concentrated effort brings it to the market of the world.

Wise men these days are not prospecting for business and wise buyers of railroad materials are watching the steady, consistent effort of the advertisers in

Railway Engineering and Maintenance

MORDEN

TRACK SPECIALTIES

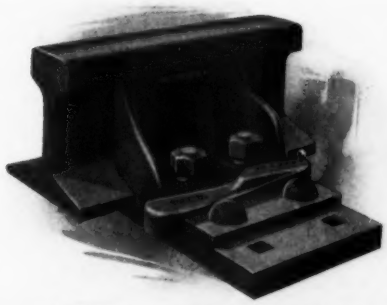


ADJUSTABLE GUARD RAIL CLAMP

A clamp for heavy service with universal drop forged yoke made of special heat treated steel.

This clamp is GUARANTEED. A clamp that is not dependable is expensive at any price.

Made for rails from 80 to 130 lbs. per yd.



ADJUSTABLE RAIL BRACE

A heavy malleable brace for general use on switches, slip switches and guard rails.

Should be in use on all interlocked switches to insure an easy and close adjustment for taking up wear between rail, brace and plate.

MORDEN FROG & CROSSING WKS.

CHICAGO

Manufacturers of

FROGS, CROSSINGS, SWITCHES SWITCH STANDS, GUARD RAIL CLAMPS

All Kinds of Standard and Special Track Work for Steam and Electric Railways

COMPROMISE JOINTS, RAIL BRACES, TIE BARS, DERAILS, SLIDE PLATES, ETC.

PUMPS

A TYPE FOR EVERY SERVICE

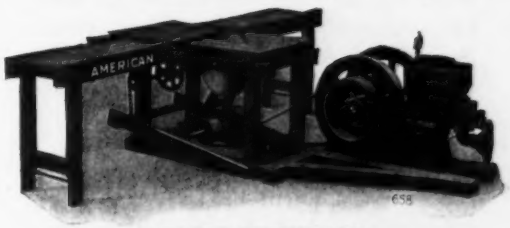
Bulletins on request

THE GOULDS MANUFACTURING COMPANY

SENECA FALLS, N. Y.

GOULDS

Cutting Construction Costs



SET FOR CUTTING OFF

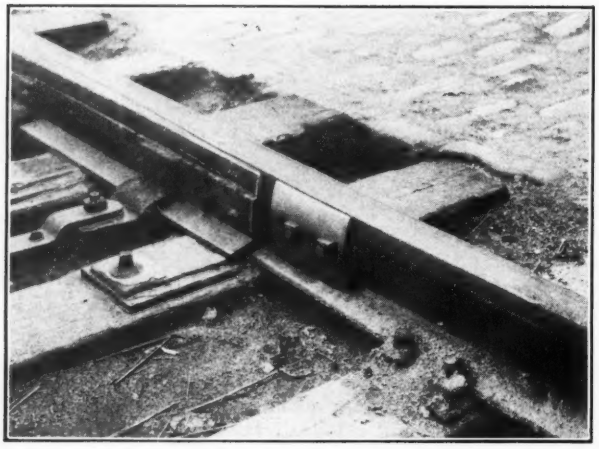
A handy, Portable Rip and Cut-off Machine—20-inch saw, handles stock up to 6 inches thick and 16 inches wide. Nothing better for hurry-up construction jobs. Furnished with or without power. Ask for Bulletin No. 80 of Portable Woodworking Machinery.

SET FOR RIPPING

American Saw Mill Machinery Co.

164 Main Street Hackettstown, N. J.

The "Mack" Switch Point Protector



An Economic Device
A Safety Device

Let the Mack Switch Point Protector absorb the wear and increase the life of your switch points.

Mack Switch Point Protectors are simple, inexpensive, and positive in action. For switch points to last ten times longer with this protection is not uncommon in actual service tests.

Mack Switch Point Protectors perform two essential functions—aiding in more economical maintenance by greatly prolonging the life of switch points,—and as a safety device by eliminating the possibility of derailment at switches.

Installation can be made easily at small cost—replacements are made in a few minutes by one man—their efficiency is not impaired by weather conditions.

Write

J. R. FLEMING & SON CO., Inc.
SCRANTON, PA.

PATENTED IN U. S. AND FOREIGN COUNTRIES

October Is Your Opportunity

The annual convention of the Roadmasters' and Maintenance of Way Association will be held in Kansas City, Missouri, on September 22, 23 and 24.

Railway Engineering and Maintenance

for October will be issued in advance of its regular date, to permit it to be distributed at the convention. It will contain all reports to be presented at that meeting.

This issue thus offers advertisers distinct advantages as a means of bringing their product to attention of the members at the time they are directly interested in discussing the subjects to which these products relate.

Special Advantages of the October Issue

FIRST—THE OCTOBER ISSUE will be in the hands of every attendant at the convention from opening to adjournment. The officers of the Association rely upon Railway Engineering and Maintenance for their copies of the reports and the reports are read from it on the floor of the convention.

SECOND—As its contents will form the basis of all discussions, its advertising pages will be used as a source of reference in these discussions and in outside exchange of views.

THIRD—Advertisers whose products are represented in its pages will have their special "talking points" in front of those who are discussing reports on any phase of track work.

FOURTH—Following the convention the forms will be reopened and as many pages added as may be necessary to cover the discussions and the activities of the Roadmasters' Association and the Track Supply Association—thus completing the record.

FIFTH—In addition to the advantages named above, the advertiser in the October issue will receive the benefits of the regular issue as well as of the additional circulation.

MAKE YOUR RECORD COMPLETE

by using liberal space in the October issue. The time is ripe for advertising. The roads must buy and are buying.

FORMS CLOSE SEPTEMBER 12

Make your reservation for space now and secure the benefits of the regular issue and the 1000 extra circulation.

RAILWAY ENGINEERING AND MAINTENANCE

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AMES SHOVELS

The World's Standard

If you must use shovels, why not buy the best?

They cost no more.

Your supply house carries them.

OLIVER AMES & SONS CORP.,
North Easton, Mass.
(Ames Shovel and Tool Co., Boston, owners)

Kilby Frog & Switch Co.

Birmingham, Ala.

Manufacturers of

Railroad Crossings, Frogs and Switches

Manganese Track Work a Specialty

Balkwill Cast Manganese Articulated Crossings

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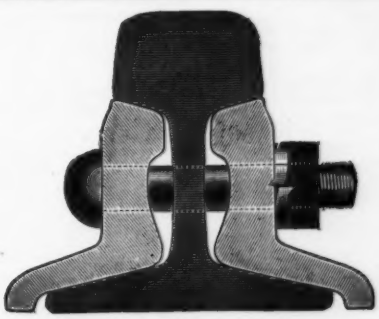
(The Savers of Maintenance)



POSITIVE LOCK WASHERS

Put a Positive under every nut and *know* that nothing will loosen the bolt but a wrench.

That feeling of security is profitable as well as pleasant.

Write for details.

WE ALSO MAKE "PLAIN LOCK WASHERS"

The POSITIVE LOCK WASHER CO.
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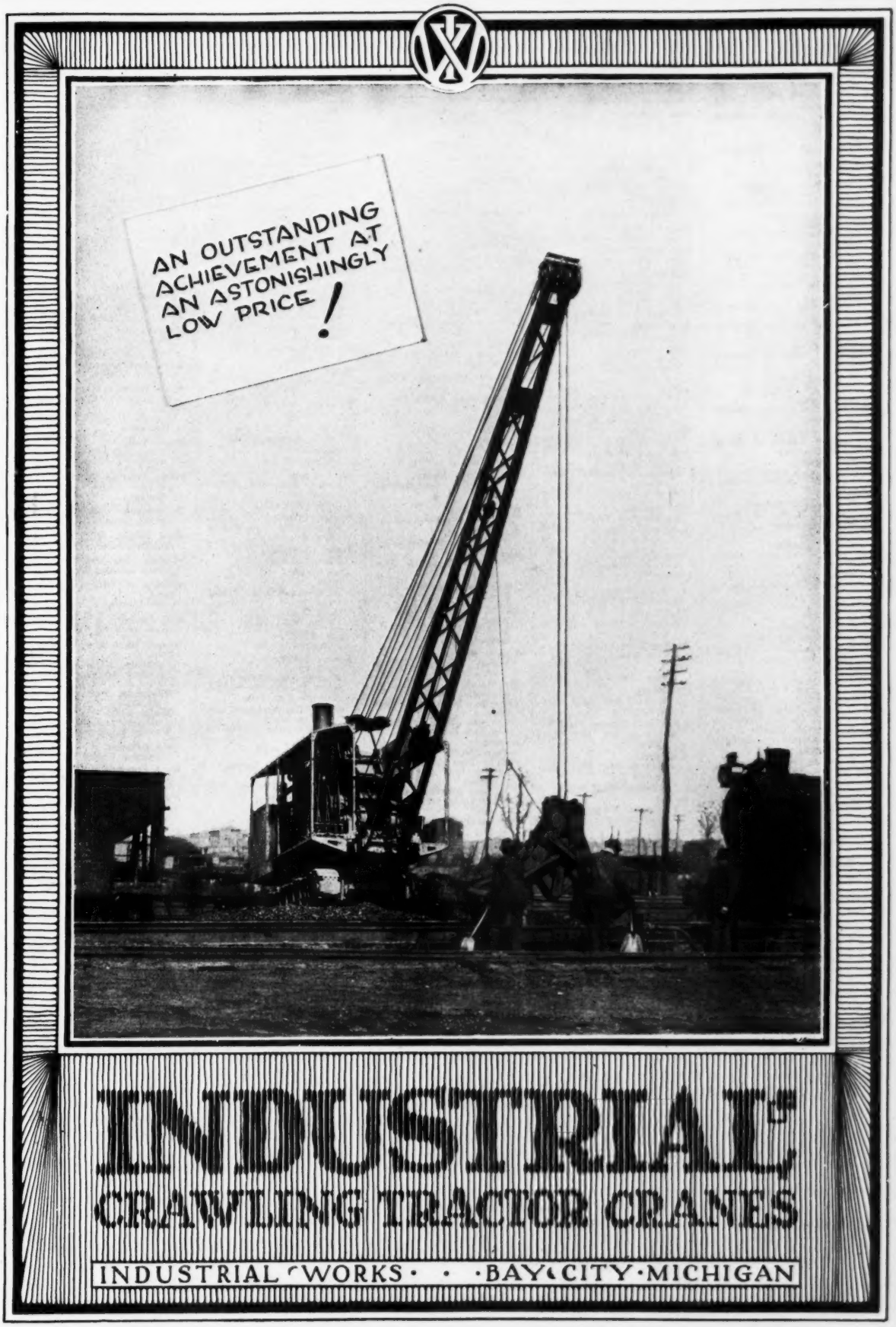
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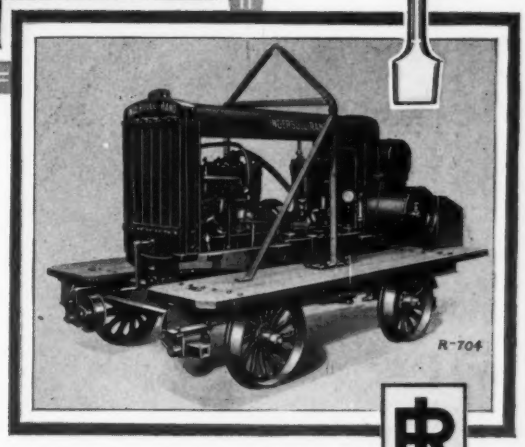

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